Prevention | Rescue | Resuscitation

The influence of New Zealand lifeguarding practice on global drowning prevention

A critical commentary and public works submitted to Middlesex University in fulfilment of the requirements for the degree of

Doctor of Professional Studies by Public Works

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Abstract

Drowning is a serious public health issue and leading cause of unintentional injury mortality worldwide. Of the 320,000 deaths annually, most occur in low- and middle-income countries (LMIC). Not all drowning is fatal, but some survivors suffer long-term or permanent disability. Prompt rescue and resuscitation offers patients the best chance of survival. Prevention is the most important step in the Drowning Chain of Survival, and with drowning an ever-present risk at beaches and other aquatic locations, lifeguards play a critical role in this regard.

The aim of this context statement is to critically review a series of public works in the field of drowning prevention, rescue, and resuscitation. The works originate from the author's career as a New Zealand-based lifeguard, researcher, and health professional. Along with exploring their impact on the sector, the statement will outline the author's role in producing the works, professional development, autoethnography as it relates to work-based learning, reflection on practice, future application, and recommendations for other practitioners in the field.

Key actions from reflecting on practice include validating selected public works to ensure they are evidence-based, bridging the know-do gap, seeking answers to new and existing research questions, using work-based learning in the design of prospective studies, and promoting diversity with the sector. Significant achievements were the establishment of Pakistan Life Saving (PALS), foundation of the International Drowning Researchers' Alliance (IDRA), and the creation of drowning prevention models that have received high-level endorsement.

Conclusions are that work-based research contributes to the body of knowledge within the industry and that New Zealand lifeguarding practice has had a significant impact on global drowning prevention. There is no standardised evidence evaluation framework or system for grading practice guidelines in lifeguarding. It is recommended, therefore, that the profession embarks on creating one. To further assist in translating evidence into practice, practitioners who work across academia and operationally should be engaged at all levels of the sector.

Autoethnography, as a method of self-reflection, has not been widely used in lifeguarding. It can be employed to increase the body of knowledge, especially in relation to non-technical skills and organisational culture. A suggested application is in the study of human factors, for which there is a lack of information and educational resources. Succession planning within the sector is vital. One way to achieve this is for new researchers to join or align themselves

with a water safety organisation and find an experienced practitioner to mentor them.

Attendance at the World Conference on Drowning Prevention and other similar events is advised to foster interest in a specialty subject area and help establish professional networks. This may lead to opportunities for collaboration on research projects or multicentre studies. Emerging leaders and delegates from LMICs should be encouraged and financially supported to attend these events. Lastly, future public works should always be developed with the end-user in mind, consider the applicability in LMICs, and be open-access wherever possible.

Disclaimer

The opinions expressed in this context statement are solely those of the author and do not necessarily reflect the views of the organisations to which the author belongs, the supervisory team, Middlesex University, or the examiners of this work.

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In it for life.

Table of Contents

List of Abbreviations

ANZCOR	Australia and New Zealand Committee on Resuscitation
ASLSA	Auckland Surf Life Saving Association
CPR	Cardiopulmonary Resuscitation
DPA	Drowning Prevention Auckland
ERC	European Resuscitation Council
HIC	High-Income Country
IDRA	International Drowning Researchers' Alliance
ILCOR	International Liaison Committee on Resuscitation
ILS	International Life Saving Federation
LMIC	Low- and Middle-Income Country
MDT	Multidisciplinary Team
MPS	Medical Position Statement
NGO	Non-Government Organisation
NZRC	New Zealand Resuscitation Council
NZWSSS	New Zealand Water Safety Sector Strategy 2020
PALS	Pakistan Life Saving
PSLSC	Piha Surf Life Saving Club
PWDP	Public Work in Drowning Prevention
SLS	Surf Life Saving
SLSNR	Surf Life Saving Northern Region
SLSNZ	Surf Life Saving New Zealand
WAI	WaterSafe Auckland Incorporated
WCDP	World Conference on Drowning Prevention
WHO	World Health Organization
WSNZ	Water Safety New Zealand

Chapter 1. Introduction and aims

Drowning is a serious public health issue and leading cause of unintentional mortality and morbidity worldwide, especially in low- and middle-income countries (LMIC). Drowning claims the lives of an estimated 320,000 people every year (World Health Organization, 2020), with the actual figure most likely higher due to significant under-reporting. According to the World Health Organization (2008) [WHO], for children aged 0-17 years, drowning is second only to road trauma as a prime cause of death from accidental injury.

Despite high-income countries (HIC) like New Zealand and Australia having national water safety plans (Water Safety New Zealand, 2015; Australian Water Safety Council, 2017) supported by an integrated network of lifeguard, rescue, and emergency medical services, drowning remains a leading cause of death also (Health Quality and Safety Commission New Zealand, 2016; Australian Institute of Health and Welfare, 2015).

A recent study out of Queensland by Wallis et al. (2015) reported that for every fatal drowning involving a child or adolescent, ten others were rescued, may have required resuscitation, and survived. Two-thirds of these survivors required hospitalisation. Despite most drowning incidents being non-fatal, some of these survivors will suffer long-term or permanent disability. As Maude (2016) describes in his article *The Cost of Those Who Survive Drowning*, these disabilities come at a high personal, social, and economic cost.

Prevention is the most important step in reducing drowning, with prompt detection, rescue and resuscitation offering drowning patients the best chance of survival (Szpilman et al., 2014). The only factor shown to be prognostic of survival is submersion duration (Quan, Mack and Schiff, 2014). For this reason, the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention (2001) has identified that lifeguards play a critical role in drowning prevention given the omnipresent risk at beaches, pools, and other aquatic locations.

The aim of this context statement is to present and critique my public works in the fields of drowning prevention, rescue, and resuscitation. The public works originate from my professional career in surf life saving (SLS), water safety, and advanced life support education. Along with an exploration of how they have impacted on national and international drowning prevention, I outline my involvement in their production, professional development, critical analysis and learning from reflective practice (Gibbs, 1998), future application for the works,

and recommendations for other practitioners in the field.

The framework for the critique and sector impact will be the recommended actions in the Drowning Chain of Survival (Figure 1.1) by Szpilman et al. (2014). This is a model that has been adopted by the International Life Saving Federation (ILS) and European Resuscitation Council (ERC), and is one of my selected public works in this context statement (International Life Saving Federation, 2014; European Resuscitation Council, 2015).

Figure 1.1: The Drowning Chain of Survival "refers to a series of steps that when enacted, attempts to reduce mortality associated with drowning" (Szpilman et al., 2014, p.1149) and aquatic rescue.

The Drowning Chain of Survival provides a contemporary and concise precise of the most critical advice actions at each stage of the drowning process. As will be discussed in Section 4.1, the model takes the form of a Haddon Matrix (Haddon, 1999), and each public work in drowning prevention (PWDP) relates to at least one link of the chain. In the six years since first being published, the model is now well established within the sector and frequently referenced by other researchers (Google Scholar, 2020).

ILS has recommended, "that the Drowning Chain of Survival be used for general guidance to all involved in preventing or taking action in a drowning incident" (International Life Saving Federation, 2016, p.1). The intended use of the model is as follows:

- In public and professional drowning prevention/water safety education programmes and signage at aquatic locations
- As a cognitive aid (to refer to during an emergency)
- To provide a framework for emergency response systems (for lay rescuers, lifeguards, emergency and rescue services, aquatic sport participants/clubs/ associations)
- In support of funding applications for drowning prevention programmes, public rescue equipment and lifeguard services, and

- To guide policy development (in government agencies, non-government organisations [NGO], and public safety/rescue organisations).

1.1 Overview of the context statement

The purpose of the context statement is multifaceted, but the primary outcome is to critically reflect on my PWDPs through this piece of work and consider the impact of New Zealand lifeguarding practice on global drowning prevention. Using established theoretical models of reflective practice, I will demonstrate:

- The factors that have inspired me to create PWDPs, and how this has been used to influence the lifeguarding and drowning prevention sectors
- The contextual nature of the works as they relate to the current body of knowledge within my professional fields
- The translation process, multidisciplinary approach, communication strategies used in creating the works, and the impact this has had on the final product
- What knowledge and skills I have gained from the works themselves and getting them into the public domain, and
- My learning and professional development obtained through undertaking this critical review, and how it relates to my future roles within the sector [Adapted from the DProf Candidate Handbook (Maguire, 2012, p.11)].

The context statement is divided into ten chapters, with selected examples of the public works included in the appendices. The first section of this chapter has provided an overview of drowning prevention and lifeguarding from a public health/injury prevention perspective. In the next section, an international perspective on drowning prevention from the two leading governance bodies and the core themes informing the context statement is reviewed.

Chapter 2 provides an overview of my career and personal development, with specific reference to the factors and people that have motivated and inspired me to work in this field. The discussion incorporates an evaluation of the principles from a personal, professional, and ethical standpoint that have guided me in the development of the PWDPs. The chapter concludes with a critique of the nature of evidence required by the different audiences that I address, and the way it is presented and validated for each.

In Chapter 3, a theoretical framework for reflective practice and an overview of the research methodologies used, including the theories that inform empirical research and autoethnography is described. The public works themselves are described in Chapter 4, and Chapter 5 begins with a critical review of the PWDPs at all stages of my involvement in their production. The impact of the public works is discussed along with selected examples of their use in the media, and adoption into various activities and outputs by organisations from both inside and outside the sector.

In Chapter 6, the drowning problem in New Zealand is discussed, and I consider the geographic environs that make water a hazard, societal issues, and my connection with the agencies that are working to address this. A critical reflection on my role as facilitator and influencer between practitioner and academia, with reference to knowledge translation and the nature of evidence, is the basis for Chapter 7.

Chapter 8 begins with an account of the personal development and learning gained through producing public works, the application of my skills and knowledge to these projects and concludes with a critical reflection on how this has influenced my practice. This reflection explores the use of autoethnography as a method for self-reflection. The use of this approach in the production of public works and emerging links to human factors and increasing the body of knowledge in lifeguarding is also discussed.

In Chapter 9, I consider the future impact of the PWDPs and opportunities for further research. And finally, in Chapter 10, I summarise the key findings of the context statement and provide recommendations that may be useful for other practitioners working in the fields of drowning prevention, lifeguarding and resuscitation.

1.2 Global influences in drowning prevention

The two preeminent organisations in drowning prevention from a global perspective are the WHO and ILS. While the focus of these organisations is somewhat different, both share a common goal of wanting to reduce the global burden of drowning. For the WHO, a public health approach dominates. This involves four phases: surveillance, to identify what the problem is; risk factor identification, to determine what is the cause; intervention evaluation, to see what works; (and) implementation, to determine how it will be done (Centres for Disease Control and Prevention, 2014). With ILS, the focus has historically been on the

provision of lifesaving services, e.g., beach lifeguard patrols and hosting lifeguard-sport competitions. In recent years, however, it is the author's view that there has been a shift in emphasis from rescue and resuscitation to prevention (International Life Saving Federation, 2019). While prevention is the most important intervention in reducing drowning, this critical commentary will focus on the role of the lifeguard.

World Health Organization

The WHO has stated their goal is "to improve equity in health, reduce health risks, promote healthy lifestyles and settings, and respond to the underlying determinants of health" (World Health Organization, 2019a). In 2014, the first *Global report on drowning* was published by the WHO (World Health Organization, 2014):

> "The report pointed out that drowning has been highly overlooked…, and that…more should be done by governments and the research and policy communities to prioritize drowning prevention and its integration with other public health [interventions]. At country level, WHO has worked with Ministries of Health in some low- and middle-income countries to prevent drowning…[by using barriers to control]…access to water and [establishing] day care centres for pre-school children. In addition, WHO has also funded research in low-income countries exploring priority questions related to drowning prevention. [Regionally]…, WHO organizes training programmes and convenes workshops to draw together representatives of governments, NGOs and UN agencies working on drowning prevention" (World Health Organization, 2019b).

This publication, and *Preventing drowning: an implementation guide* (World Health Organization, 2017), has had a major influence at an international (collaborative), national (strategic), and local (community) level (Meddings, 2015; International Life Saving Federation, 2019). Both address drowning prevention strategies in all countries but emphasise the fact that 90% of deaths occur in LMICs. The publications have attained their status by taking an evidence and best practice approach to evaluating drowning prevention strategies used in a variety of high and LMICs, and distilling them into a series of recommendations that can be applied in any setting.

To this end, a series of ten evidence-based interventions and strategies (Figure 1.2) have been developed by the WHO that set out in simple terms the measures that need to be employed to address the drowning problem. Like other forms of injury prevention, for example, road traffic crashes, no single measure is enough; a coordinated effort is required.

They are divided into five community-based interventions, four at the regional, state or national level, and all underpinned by an overarching recommendation for more research to address priority research questions (World Health Organization, 2014, p.ix).

Figure 1.2: The ten interventions and strategies selected by the WHO as the best evidence-based approach for the prevention of drowning at a national or community level. Image credit: World Health Organization.

The interventions are evidence-based ones that have proven effective in HICs, but that can also be applied in LMICs. They acknowledge that the highest rates of drowning involve

children, and even in those countries surrounded by water, most drowning incidents occur inland. In LMICs, drowning is usually associated with collecting water, living near water, travelling on water, working on or around water, and flooding disasters (World Health Organization, 2014, p.12). These interventions and strategies now provide the basis for drowning prevention worldwide.

Through events like the World Conference on Drowning Prevention (WCDP), and numerous international aid and assistance programmes, there is now a greater awareness of the magnitude of the problem in LMICs and low-cost measures that do not rely on high-technology or commercially available solutions. Disappointingly, government funding is seldom if ever proportionate to the magnitude of the problem, and in some countries, drowning prevention only exists because of philanthropic support or volunteers.

International Life Saving Federation

The history of ILS can be traced back to the end of the 19th century. According to ILS:

> "Organised international life saving activities date back to 1878 when the first World Congress was hosted in Marseille. In the decades since, there have been many outstanding…national life saving achievements. A need for an international forum to exchange ideas was soon recognised. This led firstly to the establishment of the Fédération Internationale de Sauvetage Aquatique (FIS) and then…the formation of World Life Saving (WLS). Both organisations were established to promote still-water and surf life saving objectives throughout the world. FIS and WLS merged in 1993 into the ILS" (International Life Saving Federation, 2019a).

ILS is comprised of four regional branches: Africa, Americas, Asia-Pacific, and Europe, to which 137 individual member organisations belong. "ILS leads, collaborates and partners with national and international organisations to prevent drowning, to promote the provision of lifesaving services and oversee lifesaving sport throughout the world" (International Life Saving Federation, 2019b). The operational arms of ILS are referred to as commissions and include drowning prevention, rescue, sport, and business. New Zealand is represented on ILS by Surf Life Saving New Zealand (SLSNZ), which is a full member federation.

Apart from Australia and Great Britain, ILS only allows one full member per country. Full members are afforded voting rights, whereas other categories of membership, including associate, corresponding, partner, and institutional are non-voting (International Life Saving Federation, 2019c). Excluding institutional members, all ILS members must be "a lawfully

incorporated national non-profit organisation that is a leader or provider of drowning prevention, lifesaving and/or lifesaving sport activities in its nation" (Ibid.).

In addition to organising events like the WCDP and Lifesaving World Championships, ILS produces medical and lifesaving position statements on a variety of topics for use by lifeguards, lifesaving agencies, and other aquatic safety professionals (International Life Saving Federation, 2019d, 2019e). A range of qualification certificates in lifesaving, e.g., ILS Lifeguard Beach and ILS Rescue Boat Crew are also available for delivery by member organisations or equivalency endorsement by ILS (International Life Saving Federation, 2019f). In fulfilling these functions, ILS considers its role that of peak body in lifesaving and drowning prevention.

Other organisations

Several other organisations, such as the United Nations, United Nations Children's Fund, Royal National Lifeboat Institution (RNLI), and the Centers for Disease Control and Prevention (CDC) provide strategic oversight, policy, funding and expert advice either internationally or to selected other countries, and in the author's opinion, also have a key influence on drowning prevention globally. The work of SLSNZ, Surf Life Saving Australia (SLSA), and Royal Life Saving Australia must also be acknowledged for what they do not just in the Asia-Pacific region, but wider afield also.

The final influencing factor of note is that most agencies involved in water safety and drowning prevention, and many who provide lifeguard services, are either NGOs or charities that receive no government funding. To use New Zealand as an example, Water Safety New Zealand (WSNZ), SLSNZ, and Coastguard are all NGOs; none of them are government-funded. In comparison, the New Zealand Government (2016) announced a $600m investment to reduce the country's road toll. The lack of funding for SLS has recently been the subject of public debate (Maude, 2018; 1 News Now, 2018), as has funding for core emergency services in New Zealand, such as the ambulance service (NZ Herald, 2019).

Chronic under-funding is common in other countries around the world, e.g., Pakistan where the continued existence of drowning prevention agencies and lifeguard services is dependent on volunteers giving of their time or commercial funding streams, e.g., hotels or tour operators. While a lack of funding is common in LMICs, lifeguard services are sometimes seen as a low priority by city officials in HICs, like the USA (Malewitz, 2018). Funding is often

only forthcoming in response to public outrage, for example, when there is a spike in tourist drownings (Offley, 2019; TTG Asia, 2018). This, coupled with the fact that in many jurisdictions around the world, including New Zealand, there is no statutory requirement to provide lifeguard services or other safety measures on beaches (Liverpool Echo, 2005).

As committed as these volunteers and agencies are, there is a limit to what can be achieved when the time that could be spent on service delivery is taken up with fundraising (Binning, 2019). Therefore, despite recognition from organisations like the WHO and CDC of the significant burden of drowning, and the work of regional, national, and international organisations to address this, the financial and human resources available have historically been inadequate.

1.3 Core themes informing the context statement

In Section 1.2, the key influences in drowning prevention from a global perspective were discussed. There are, however, other themes to consider given the multi-agency/multifaceted nature of drowning prevention. These themes represent contemporary socioeconomic and sector-specific issues that if not already considered by agencies, should be.

Increased use of data to guide investment and interventions

We have already learnt that drowning is a serious public health issue. It claims the life of one person every 1.5 seconds (World Health Organization, 2014). According to Water Safety New Zealand (2018), males are four times more likely to drown than females, and most pre-school drownings occur in pools, bathtubs, and other bodies of water located near the child's home, e.g., ponds. Very few school-aged (5-14 years) children drown in high-income countries (HIC), with the next peak relating to older adolescents and young adults (15-34 years), middle-aged adults (45-54 years), and older adults (65+ years) taking part in aquatic recreation in and around bodies of open water; for instance, beaches, lakes, and rivers (Figure 1.3).

The use of data to guide investment and target activities towards high-risk groups is now the norm. However, many organisations have only sufficient resources to reach some of these individuals and communities. A lack of funding and reliance on volunteers presents additional challenges in ensuring that those who do not fit the high-risk profile, e.g., females, sailors, and whitewater canoeists/kayakers are not neglected, as they also contribute to the drowning toll. It goes without saying that the lives of these people are equally important. This

highlights an important theme informing the context statement; many of the goals in drowning prevention, such as SLSA's "zero preventable drownings", are aspirational (Surf Life Saving Australia, 2019). They will likely remain ambitious goals until governments recognise drowning as a serious public health issue, and the sector is adequately resourced in the same way that other areas of injury prevention are.

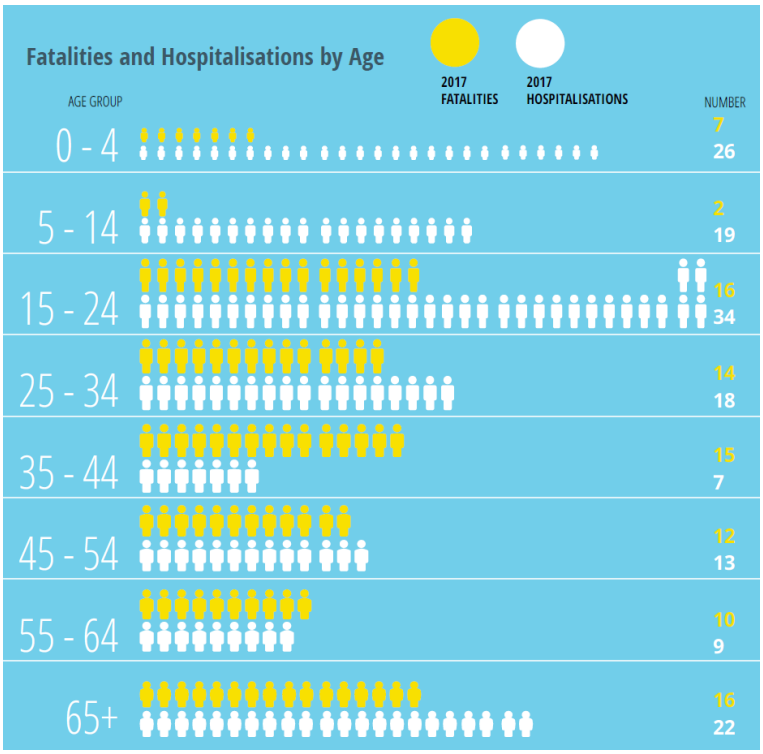

Figure 1.3: New Zealand drowning fatalities and hospitalisations by age 2017-2018. Image credit: Water Safety New Zealand.

Low and middle-income countries have different needs to high-income countries

The reasons for drowning in LMICs relate more to sustenance as opposed to recreation. Most locations involve wells and other small bodies of water, the workplace, e.g., rice paddy fields, combined with a lack of supervision of children, and an inability to swim and cope when in difficulty (Tyler et al., 2017). The ability to address the latter is compounded by limited or no qualified teaching staff, a lack of suitable training facilities, and even cultural aspects that prohibit the teaching of lifesaving interventions like cardiopulmonary resuscitation (CPR). Often, no formal lifeguard, rescue, or emergency medical services exist in these locations.

Significant under-reporting occurs in LMICs because national data systems either do not include these details in their reports, or official documentation is not required to bury/ cremate a deceased person. Limited data are available because many victims are pronounced

dead on-scene or never transported to hospital. They are not, therefore, formally recorded in any registry (World Health Organization, 2014). For this reason, how drowning is addressed in LMICs requires a different approach; strategies used in HICs cannot merely be replicated.

Injury prevention models used by other public safety organisations

In Section 4.1, the Haddon Matrix, an established injury prevention model, will be described as it applies to the Drowning Chain of Survival. When evaluating these models from a more wholistic perspective, it is useful to compare the outputs of the water safety sector to the strategies outlined in generic injury prevention models, as used by other public safety agencies. One such model that is particularly relevant is The Spectrum of Prevention (Figure 1.4) by Cohen and Swift (1999).

Figure 1.4: The Spectrum of Prevention by Cohen and Swift is a tool for developing a multi-level approach to injury prevention. Image credit: HRiAHealthComm.

The Spectrum of Prevention was "derived from practice and developed out of the conviction that complex problems require comprehensive solutions" (Ibid., p.203). Few water safety practitioners would disagree with the notion that drowning is a complex, multifaceted problem. Organisations like Surf Life Saving Northern Region (SLSNR), whether by design or coincidence, to a greater extent follow this model. Evidence of this can be seen in the organisation's strategic plan (Surf Life Saving Northern Region, 2018). Cohen and Swift (1999, p.204) cite pool fencing as an example of a strategy that unless implemented across multiple levels, may fail, e.g., a homeowner has installed a pool fence, but no law exists requiring a

self-latching, outward-opening gate. This could result in a drowning incident. The complexity of injury prevention at an individual level, i.e., personal responsibility, knowledge and survival skills, through to policy and legislation that may or may not be enforceable in an open-water environment, does lend itself, therefore, to models such as these.

Not all drowning is fatal

Since 2003, the number of hospitalisations in New Zealand due to drowning had been rising at a rate higher than deaths have been falling. For the 66 preventable drownings that occurred in 2018, a further 204 people required hospital treatment (Water Safety Reports, 2020). To date, no explanation for this has been found. Possible reasons may include a lower threshold to transport by paramedics or an increased awareness by parents and caregivers of the need to have non-fatal drowning victims medically assessed. Further research is required, however, to investigate and substantiate these hypotheses.

What the data does not reveal, and hence why it is relevant to this context statement, is that some survivors of drowning do not make a full recovery and suffer life-long disability. This comes at a substantial personal, social, and economic cost to not only the individual but their family, society, and the economy. It is essential, therefore, when evaluating the PWDPs submitted in this context statement that we consider not only fatal drownings but non-fatal drownings too.

Challenges facing volunteer-based organisations

Most organisations involved in drowning prevention, apart from government departments and fully funded emergency services, are NGOs or charities. In the case of SLS, an organisation that I belong to, they rely heavily on volunteers for providing their human resource. Most lifeguard services in New Zealand are provided by volunteers at the weekend and public holidays, supported by paid staff who patrol weekdays at some locations. In other parts of the world, for example, the USA, lifeguard services are comprised entirely of paid staff.

A recent report by Sakofsky and Cooney (2017) for Volunteering New Zealand noted that from 2004-2013 there was a 42% decrease in volunteer hours, a 21% increase in the number of volunteers, and a 30% increase in paid staff working for non-profit institutions. It is the author's view that due to an increasing population there is a larger pool of people attracted to the opportunities and rewards that organisations like SLS provide them with, as they always have, however, due to societal changes, e.g., more time being spent at work, the

number of available hours they have to volunteer is reduced. The report notes several issues and barriers for volunteer-based organisations and their members:

> "There are many complex changes occurring in the context of volunteer engagement in New Zealand which create challenges for the organisations that rely on them. These include:
> - the rising cost of volunteer engagement
> - inadequate resources
> - increased compliance and reporting requirements
> - organisational barriers" (Sakofsky and Cooney, 2017, p.9).

In an organisation like SLS where the work by its very nature is inherently dangerous, due to frequent exposure to natural hazards such as large waves, rip currents, and rock faces, adapting to a legal environment where health and safety legislation that once applied only to paid employees, but now includes volunteer workers, has required a culture-shift. This has come about due to changes in the Health and Safety at Work Act 2015. Although many volunteer organisations are exempt under the act, SLS is not because their workers, i.e., lifeguards are integral to the operation of the organisation (Health and Safety at Work Act 2015; New Zealand Government, 2019).

The key changes that SLS has had to adopt include strengthening its risk management policies and shifting the focus from monitoring and recording incidents to proactively identifying and managing risks. There is also greater legal responsibility on directors and executives of an organisation to manage risks and keep people safe (Site Safe, 2019). In many cases, this culture-shift is still a 'work in progress', with some SLS clubs still coming to terms with their obligations under the new legislation.

Time and financial pressures are also a consideration when a person decides to volunteer. The report identifies that younger people are less inclined to make a long-term commitment and volunteers are "constantly looking for new and meaningful experiences" (Sakofsky and Cooney, 2017, p.11). Issues like increased travel time due to traffic congestion have been recognised as barriers to volunteerism. For SLS and other NGOs involved in water safety, this presents a real concern given the reliance they have on volunteers to achieve their mission, and in the case of lifeguards, provide vital services to the beachgoing public.

Research outputs must be relevant to the end-user

Scientific research is one of the categories of PWDPs submitted in this context statement. The

aim of this research is for it to be used by lifeguards to improve outcomes for drowning victims and applied by policymakers to inform resource allocation and priorities in regional, national, or global drowning prevention strategies. While the sector has acknowledged the importance of research when it says "research and evidence drives investment decisions and continuous improvement" (Water Safety New Zealand, 2015, p.6), it is my view that there is a lack of evidence for some of the investment and interventions that occur, and a distinct void when it comes to assessing their efficacy.

An example of this is that WSNZ fund Plunket to manage pre-schooler drowning prevention, specifically through the provision of bathmats into homes of babies aged 5-7 months. These bathmats, which have water safety information printed on them, are provided during home visits from Plunket nurses. In 2019, $150,000 was allocated for this purpose (Water Safety New Zealand, 2019). While anecdotally these bathmats are well received and appreciated by new parents, there is no evidence to show they do anything to reduce drowning in children under five years of age.

For research to be relevant, it must have a tangible benefit, e.g., a positive impact on reducing drowning or improved efficiency/ease of completing a task for rescuers. The challenge for the researcher or organisation intending to implement the results is to answer the 'so what' question. Put another way, how do the results change what I do as a lifeguard, and what are the barriers to implementation, such as cost and additional training required. There is an increased call for ethics committees to assess not only the scientific benefit of research but also the societal benefit (Shaw and Elger, 2013). One thing most practitioners agree on, however, is that more research is needed, and this starts with identifying gaps and developing a prioritised research plan. The relevance to this context statement is that almost all my PWDPs have their origin in applied lifeguarding practice.

Demographics and the physical environment

The final core themes informing the context statement are the social demographic and environmental changes that are occurring where drowning prevention measures take place, where the actual drownings occur, the communities at which these measures are aimed, and the natural environment that lifeguards and other aquatic rescuers operate in. Using New Zealand as an example, in the last 90 years the population has increased by 3 million people (Figure 1.5). The implications of this growth are far-reaching. In the first instance, more people

may look to engage in aquatic recreation and activities, and as these locations become crowded, people seek out other places to go where lifeguard, rescue, and ambulance services are not readily available. Furthermore, as the population increases, so too does the frequency of exposure to hazards.

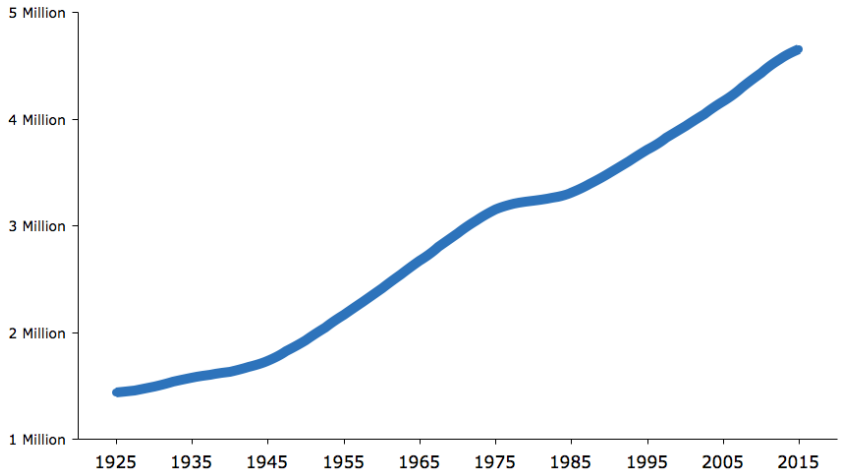

Figure 1.5: New Zealand population growth 1925-2015.
Image credit: Country Digest.

Population growth has been shown in other areas of injury prevention to be one variable that increases mortality rates; however, this effect is more evident in LMICs (Razzaghi et al., 2019). Statistics New Zealand (2018) state that "New Zealand's population…has a 90 per cent probability of increasing to 4.89–5.14 million in 2020, and to 5.01–5.51 million in 2025". The ethnic diversity of the population presents several challenges for all drowning prevention and lifeguard agencies, and some of these, as they relate to New Zealand, are discussed in Chapter 6.

The final theme informing the context statement is changes that are occurring to the physical environment, specifically those concerning extremes in weather conditions. This includes natural disasters that are hydrological like storm-tides, tsunamis, floods, and water transport incidents. According to the United Nations (2018), 90% of natural disasters are weather-related:

> "It is estimated that by 2050 rising populations in flood-prone lands, climate change, deforestation, loss of wetlands and rising sea levels are expected to increase the number of people vulnerable to flood disaster to 2 billion. Between 1900 and 2007, water-related disasters outnumbered all other types of disasters combined" (Ibid.).

For water safety, lifeguard, and rescue agencies this not only has an immediate effect on the number and type of incidents that they respond to, which they may not have specific expertise in, e.g., floods but there could also be added health and safety concerns for staff. Preparing for these incidents requires a new level of planning, training, and cooperation with government departments, other emergency services, and civil defence. This may require new education campaigns to ensure the public and local communities are also prepared for these emerging threats to property and life.

While many of the PWDPs submitted in this context statement were produced with the core themes discussed in this section informing them, others, due to the fact they are new or emerging themes, may not. In Chapters 7, 8 and 9, these themes and their impact will be considered in more detail.

Chapter 2. Positioning the self in context

What makes the PWDPs submitted in this context statement important from a personal and professional perspective and the motivating factors that inspired me to create them form the basis for this chapter. To explore the context in which the PWDPs have been produced, I will provide an overview of my:

- Family involvement in SLS, early influencers and mentors
- Professional and volunteer career history
- Roles that have allowed me to influence policy and affect change
- Initial venture into lifeguarding and drowning prevention research, and
- Understanding of the types of evidence required by different audiences.

The evolution of how I have formed my opinions over nearly three decades of involvement in water safety both then and now is also discussed, along with an exploration of the principles from a personal, professional, and ethical standpoint that have guided me in the development of the public works.

2.1 Family involvement in surf life saving and mentors

The Piha Surf Life Saving Club (PSLSC) was formed in 1934 in response to a need for beach patrols to keep bathers safe. This was at a time where the number of day-trippers, holiday homes being built and people staying at the local camping ground was increasing (Coney, 2009). PSLSC has always had strong family connections across many levels. Junior lifeguard programmes that involve school-age children, through to veteran lifeguards in their eighties have resulted in multi-generational members of the club.

In the late-1940s, my grandfather, Claude Webber, purchased a beachfront holiday home at Piha. He first became involved with the PSLSC after being asked to assist with fundraising and was subsequently invited to take up a position on the club's management committee. Following a longstanding involvement that included being president and patron, he was made a life member. My father, Brian, also a life member and former club chairman, has been an active lifeguard for over 60 years. At 79, he has only recently retired from active service. My mother, brother, cousins, uncle, and aunty have all had an involvement with the PSLSC, so it was not surprising that I joined and qualified as a lifeguard in 1989.

In 2015, I was the youngest person to be made a life member of the PSLSC and am in the unique and honoured position of being the only third-generation life member in the club's 85-year history. This family association with the PSLSC, coupled with the frequency that drowning incidents occur at this beach, (regarded as one of New Zealand's most dangerous [Peacock, 2017]), contributed to my becoming a lifeguard and ensuing career in drowning prevention. PSLSC has always supported my work in lifeguarding and drowning prevention at all levels, and for this, I am incredibly grateful and proud of my association with them that continues to the present day.

The Auckland Surf Life Saving Association (ASLSA) commenced helicopter operations at Piha in the summer of 1970/71 (Figure 2.1). This was the first civilian rescue helicopter service in the world (Coney, 2009). Originally only established for surf rescue work, the service evolved into a 24 hour/7 day a week full aeromedical service. Rescue helicopters, worldwide, have revolutionised search and rescue operations because of the access they provide to remote/difficult to reach locations and the speed with which they can transport critically injured patients to hospital. In cases of traumatic injury, transport by helicopter is associated with higher rates of survival (Michaels et al., 2019).

Figure 2.1: Hiller 12E Rothmans Surf Patrol Rescue Helicopter (c. 1972). Photo credit: Warren Smith Collection.

One of my earliest childhood memories is the Rothman's Rescue Helicopter landing on our front lawn, and my father and uncle assisting with refuelling. In the pioneering days of the service, my father and his life-long friend Rodger Curtice QSM undertook numerous surf

rescues that would have resulted in the loss of life had they not risked their own lives to perform these dangerous missions. Rodger, who would later become the regional controller of the service, has been a great mentor and supporter of everything that I have done in my career. Although long since retired from active service, he maintains an avid interest in all things lifesaving. His legacy will always be his willingness to risk his own life in the line of duty in those pioneering days and establishing the Auckland Westpac Rescue Helicopter Service, that still operates to this day.

Perhaps my greatest inspiration and mentor in SLS, however, was F.R. (Buddy) Lucas (Figure 2.2). Buddy was a life member of the PSLSC and ASLSA. Buddy was a gold medallist swimmer in the 1950 British Empire Games and president of PSLSC for almost two decades. No other member in the club's history has presided for this length of time. He is regarded as one of the most influential forces in the development of lifeguarding at Piha (Thompson, 2002). Buddy was a pragmatic, highly experienced lifeguard and patrol captain, and always open to new ideas and ways of improving operations.

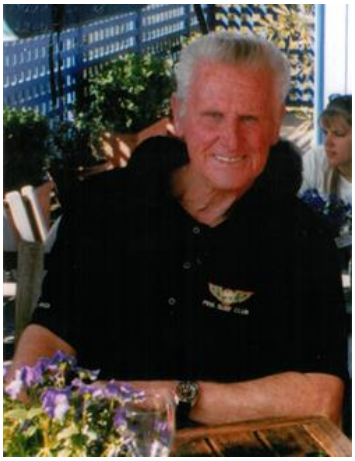

Figure 2.2: F.R. (Buddy) Lucas (1931-2002).
Photo credit: Lucas Family Collection.

Buddy never lost sight of the fact that SLS was a volunteer-based organisation; however, he did not see this as an excuse for compromising standards. He was a level head during critical incidents, always available to support younger members, a diplomat, and a peacemaker. Buddy was a well-respected leader whose legacy lives on in SLSNR scholarships aimed at promoting and encouraging emerging young leaders (Surf Life Saving Northern Region, 2020). His sudden and unexpected death was a massive loss to SLS, the Piha community, his family, fellow lifeguards, and me as a mentor and leader.

The ideals for which Buddy, Rodger, and all my family who have been involved in SLS stood is the common goal of wanting to help people in need of rescue, and prevent drowning and injury. These are the ideals that have been my primary motivators too.

2.2 Professional and volunteer career history

My role as both a paid and volunteer lifeguard has had a significant bearing on my career pathway and motivation for producing PWDPs. Soon after qualifying as a lifeguard at 15, I developed an interest in resuscitation and first aid. My first advanced resuscitation course was in 1990. This, and subsequent courses, led to me developing a broader interest in pre-hospital emergency care, and a desire to work for the ambulance service. My ambition was realised in 1994 when I was appointed as a volunteer ambulance officer for St John.

St John is one of two organisations, Wellington Free Ambulance being the other, that are funded by the Ministry of Health, Accident Compensation Corporation, and District Health Boards to provide emergency ambulance services in New Zealand (Ministry of Health, 2019). St John operates out of 209 ambulance stations nationwide, and their workforce is comprised of both paid and volunteer staff (St John, 2019). At the time, there was no degree programme for paramedics and the only way to obtain ambulance qualifications was to be a member of St John. So, I enrolled in the Bachelor of Health Science (Nursing) course. In 1997, I completed this and obtained the professional qualification of registered nurse (RN). My intention at that stage was to work full-time as an ambulance officer and train to the level of advanced care officer, a qualification now known as intensive care paramedic.

Although I have never worked as an RN (but do work in healthcare), the qualification has allowed me to fulfil other roles including event medic and hospital resuscitation training officer. Teaching resuscitation led, in part, to me developing an interest in human factors and crew resource management in lifeguarding. These non-technical skills are now an integral component of how teams of health professionals are trained to act in a crisis, and there is emerging evidence to suggest that this training may improve patient outcomes from cardiac arrest (Lockey, Lin and Cheng, 2018). Being an RN has also allowed me to participate in various healthcare-related professional boards and working groups, and to co-author publications of a medical nature, e.g., *Adult Anaphylaxis* (Auckland District Health Board, 2015). Some of these feature as PWDPs submitted in this context statement.

I was accepted full-time into the ambulance service in 1999 as a patient transfer officer, but before realising my goal to become a paramedic, I was appointed area manager for event medical services and thrust into the role of being a senior manager at just 29 years of age. It was at this point that my aspirations to become an advanced paramedic were put on hold as my career progressed in a new direction. Concurrently, and at an early stage in my lifeguarding career, I was identified as an emerging subject-matter expert in resuscitation and first aid. I was subsequently invited to be an instructor on the ASLSA Senior Lifeguard School. My passion for lifeguard and later health professional education would be harnessed and further developed under the mentorship of Nicholas Roberts, Billy Doyle, Wayne Askew and Gavin MacDonell when I was employed on a casual basis by Emcare Associates, the company that delivered advanced resuscitation training for the ASLSA.

From 2000 onwards, I was employed in the Department of Anaesthesiology at the University of Auckland, again on a casual basis (because I already had a full-time job) to teach medical and nursing students basic life support. In 2007, I was made an honorary senior clinical tutor, and in 2016, an honorary lecturer on the academic staff. By this stage, I had left the ambulance service and could work for the university on a more permanent basis. In this role, I would teach on and oversee the postgraduate Advanced Cardiac Life Support courses. I still teach at the University of Auckland, which is also my primary academic base for scientific publications (The University of Auckland, 2019).

Throughout my career, I have held several volunteer appointments for organisations at a senior operational, management, or governance level that have all been related to some aspect of drowning prevention, rescue, or resuscitation. By having a diverse, but also an inter-connected range of paid and volunteer roles, I have not only been able to acquire expertise in more than one field but also call on work-based experiences and apply these to the development of PWDPs. This, in my view, has resulted in better decisions when working in groups or committees where a consensus is required, and some of the key decision-makers or subject-matter experts may not work in the field or have any recent experience.

2.3 Ability to influence policy and affect change

Several standout roles have provided me with the ability to influence both operational and strategic policy and affect organisational change. Change, not for the sake of it, but that

improves how lifeguards, health professionals, and lay rescuers respond to emergencies and provide patient care, and that strengthens the evidence-base on which decisions are made. Being able to conduct research that informs decisions and improves outcomes for drowning victims has been rewarding, and I believe, has made a positive contribution to society.

From 2011-2017, I was appointed to the New Zealand Resuscitation Council (NZRC) as SLSNZ's representative. The NZRC "is a national voluntary body with representation from major providers of resuscitation" (New Zealand Resuscitation Council, 2019a). Twenty member organisations make up the NZRC, which "[sets] the standard for resuscitation and first aid in Aotearoa New Zealand" (Ibid.) by publishing guidelines, producing resuscitation course materials and accrediting advanced life support, neonatal life support, and first aid instructors (New Zealand Resuscitation Council, 2019b). After this term, I was co-opted to remain on the NZRC executive committee.

My involvement with the NZRC has allowed me to be directly involved in the formulation of the Australia and New Zealand Committee on Resuscitation (ANZCOR) guidelines (Australian Resuscitation Council, 2018), chair international conference sessions (New Zealand Resuscitation Council, 2016a), and take part in various workgroups that have improved the quality of resuscitation training courses offered by the NZRC. This has not only been good for my professional standing and reputation but has also allowed me to have input into other types of public works not solely related to drowning, e.g., co-authoring the NZRC's course manuals *Resuscitation – A guide for health professionals* and *Resuscitation – A guide for advanced rescuers* (New Zealand Resuscitation Council, 2016b, 2016c).

While working part-time for the University of Auckland and Auckland City Hospital, I also established and ran two successful companies on a part-time basis: Resuscitation Skills (www.resuscitationskills.com) from 2007-2015, providing advanced life support training for health professionals; (and) AquaSafe New Zealand (www.aquasafenz.com) from 2006 to the present day, supplying surf rescue equipment and consultancy services to the water safety sector. These businesses, in part, have funded my attendance at drowning prevention and resuscitation conferences, and without them, I would not have been able to participate in some of the international projects and committees that have got me to where I am today. I include these business activities in this section, as many of the organisations I represent are not-for-profit entities who were not always able to fund my overseas travel.

With the advent of social enterprise in the not-for-profit sector (Reilly, 2016), I have

been able to contribute my commercial expertise to these organisations as they look to expand their revenue base and rely less on philanthropic trusts, gaming machine grants, appeals, and donations. The expertise that I have been able to contribute includes knowledge of sponsorship and funding-proposal preparation that I have undertaken in other roles, e.g., WaterSafe Auckland Incorporated (WAI) Chief Executive, experience in sales and marketing, knowledge of costings and market-rates for other commercial activities, such as online sales, conference speaker fees, and running workshops or conferences where a fee is charged for attendance. My experience in conference planning comes from being a member of the NZRC Executive, which has financial oversight of the organisation's biennial scientific conference (NZResus2020, 2019).

In 2013, I became the first member of the ILS Medical Committee that was not a medical doctor. One of the reasons for my admission and personal motivation to join was the work-based experience I possessed and wanted to share with the group, as exemplified by Dr Linda Quan in her letter of support to my admission in this programme:

> "Jonathon has used his background as a paramedic, a lifeguard, a trainer and manager to bring real life experience and application to an otherwise very academic group who conduct research on resuscitation and drowning rescue. Surrounded by either ivory tower, physicians or sports faculty, he always brings us back to focus on practice and practicality" (Quan, 2016).

In this role, I have been able to review, contribute to and develop several medical position statements (MPS) including the *Drowning Chain of Survival, Resuscitation in Boats, and Lone-rescuer CPR* (International Life Saving Federation, 2019). These statements are used to guide best practice in drowning resuscitation, lifeguard welfare, and aquatic first aid; they are freely available to ILS members and non-members. In relation to my motivation, forming opinions, and learning how to work in a multidisciplinary team (MDT), admission to this committee was instrumental in creating opportunities to produce other PWDPs and invitations to participate in projects at an international level, e.g., *2015 Revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation* (Idris et al., 2017).

Similarly, being invited to become a founding member of the International Drowning Researchers' Alliance (IDRA) and establishing a global community of drowning prevention researchers whose interest spans a wide range of domains has, from a practical sense,

provided more opportunities for creating PWDPs. IDRA has stated that it:

1. "Seeks to promote innovative drowning-related research by serving as a platform for collaborative efforts fostering the reduction of aquatic incidents in and around water.
2. Aims to manage, coordinate and disseminate drowning research worldwide around the topics of prevention, rescue and treatment, covering different areas such as public health, educational and sport sciences, psychology and sociology (as well as policy, economics, engineering, and others).
3. Proposes to manage strategic research issues and act as the link to convert research into practical solutions, programs, resources or equipment, thereby reducing the number of drowning incidents. IDRA will collaborate with academic and governmental research centres and units to promote international exchange of knowledge and best practices in the field.
4. Aims to collect and present data from ongoing research on drowning, relating to topics of prevention, rescue and treatment, and act as a repository, stimulating policy debates.
5. Will provide technical assistance to individuals and/or organizations interested in using methodological approaches to answer their specific drowning related problems.
6. Undertakes research in its own right" (International Drowning Researchers' Alliance, 2019).

As IDRA is an organisation made up of independent practitioners, it is relatively free from some the bureaucratic, financial, and political constraints often associated with NGOs and other institutions. It is driven, therefore, by the personal motivation of the members as opposed to any external agency's goals.

At a local level, a variety of roles have allowed me to guide and influence operational activities, conduct research, and raise public awareness. These include Director of Regional Services, Director of Lifesaving and Chair of Operations for SLSNR, and Chief Executive for WAI. As Director of Regional Services, I was responsible for the collective governance of the organisation alongside other board members with specific responsibility for the regional radio network and paid lifeguard service.

As Director of Lifesaving, I had similar responsibilities at board level plus oversight of all aspects of lifeguard services in the region. This included service delivery, training and examination of new and existing members, auditing of patrol standards, support services (regional communications centre, rescue watercraft and helicopter lifeguard squads), critical

incident support debriefing and emotional welfare of lifeguards, inter-agency liaison, and accident/incident investigation. As Chair of Operations for SLSNR, I undertake a similar role, but in a non-executive capacity. As Chief Executive for WAI, I was responsible for all aspects of the organisation's operations and performance; however, there was a much stronger financial and human resources management focus than the other roles, which are all voluntary appointments.

These positions have allowed me to apply practical expertise derived in the field as an operational surf lifeguard and as a manager to make systems and process improvements, strategic and financial decisions, as well as build relationships and collaborate with other organisations. The media have interviewed me on many occasions, both in response to actual drowning incidents and where expert comment is sought (NZ Herald, 2017; Tokalau, 2019). These skills in media-relations have proven useful when providing input into community education campaigns and working with the media to provide safety messaging to the public.

2.4 Initial venture into scientific research

I can attribute my first steps in the field of scientific research to Dr Kevin Moran ONZM (Figure 2.3); co-author, mentor, and world-renowned expert in drowning prevention and water safety. My first publication, a case report co-authored with Dr Paul Baker on supraglottic airway use in drowning, was also a key motivator (Baker and Webber, 2011). Kevin, a fellow west coast lifeguard and life member of the Muriwai Volunteer Lifeguard Service whom I served on the board of WAI with for seven years, was already a well-established and active academic when he invited me to take part in a study investigating surf lifeguards perceived and technical ability in CPR.

Kevin, a principal lecturer in physical education in the Faculty of Education at The University of Auckland, played a crucial role in sparking my interest in research and continues to do so to the present day. With Kevin, I was able to see the research process unfold from all stages including posing a research question, study design, obtaining ethics approval, research methodology, data collection and analysis, write-up and submission, through to publication. Kevin continues to provide advice on research methodology, and is a co-author on many of the PWDPs I have produced and published in scientific journals (Moran and Webber, 2012, 2013a, 2013b, 2013c, 2013d; Moran, Webber and Stanley, 2017, 2018; Webber, Moran and

Cumin, 2019). Kevin will also be involved in some of the studies I have planned for 2020 and beyond (Figure 5.1).

Figure 2.3: Dr Kevin Moran receiving the insignia of an Officer of the New Zealand Order of Merit for services to water safety from the Governor General, Sir Jerry Mateparae. Photo credit: New Zealand Government.

2.5 Understanding the nature of evidence

Central to positioning the self in context is an understanding of the different types of evidence required by the audiences that the PWDPs submitted in this context statement address. These range from at the strategic level, government and policymakers, to operationally, practising lifeguards (including healthcare professionals and emergency services personnel), through to members of the public, the media, and other interested parties either from within or outside the sector. One of the challenges associated with a varied audience is the difference in how evidence is presented to and evaluated by each group.

When I reflect on my career pathway, starting as a junior lifeguard in the 1990s, there was no need to question the validity of evidence, or why we did things a certain way, provided the directive came from a more senior lifeguard or authoritative text, such as an SLS training manual. At the time, this was all the 'evidence' that was needed. Even if there was a reason to question the rationale for a policy or procedure, the hierarchy of the organisation, i.e., authority of the patrol captain or senior lifeguard would suppress any inquisitive nature we may have had. Contrast this with the junior lifeguards of today; they are encouraged, especially if they consider their safety could be compromised by a decision, to question its validity irrespective of who has made it (Doyle and Webber, 2019).

For senior lifeguards who possess this degree of influence, it is the author's opinion

that they have a moral and ethical responsibility to: ensure they can cite the evidence for their position; are aware of the biases they inherently possess; declare any conflicts of interest; (and) be overt as to whether they are offering a personal or professional opinion. While the evidence for a particular viewpoint can originate from either work-based, i.e., professional or scientific knowledge, there is an increasing expectation from the members and leaders within organisations like SLSNZ that the rationale for a new guideline, policy, or decision is supported by evidence that can be validated by research, expert opinion, or both. This has seen a shift in practice by SLSNZ where proposed policy-changes are now put out for consultation, along with an explanation of the process that will be followed to respond to feedback (Mundy, 2018). Any relevant reference, e.g., new ANZCOR guideline, is also cited.

Validating evidence presents specific challenges, especially where conducting studies in the surf environment are concerned. While some aspects of lifeguarding can be studied in a laboratory, virtual setting, or simulations using water-rescue manikins, others cannot, and agencies may have to accept that the level of evidence may not (or ever) be as high as it is in other domains, e.g., healthcare. This should not detract from the substantial contribution that lifeguards make to drowning prevention or invalidate any strategies in use. Nevertheless, in a competitive funding environment, and where human resources are scarce, there may be a place for more robust evaluation of the efficacy of some interventions, e.g., public education campaigns. This is discussed in more detail in Chapter 7.

Evidence for treatment recommendations within the healthcare system is something I have become more familiar with from my involvement in the ANZCOR evidence evaluation and first aid/resuscitation guideline writing process. ANZCOR currently use the ranking and grading system published by the Australian National Health and Medical Research Council. Evidence is ranked, based on the type of study design (Table 1), and then graded (Table 2) on the quality of the recommendation being made. The grading process is important because it addresses any bias, confounders, or adverse treatment effects not reported in the study.

Once evaluated, the grade and level of evidence are then appended to the treatment recommendation. For example, *Guideline 9.2.10 – The use of oxygen in emergencies*, states "that when bag valve mask oxygen resuscitation is used, a minimum of two trained people are required to provide ventilation for a non-breathing victim: one to manage the airway, mask and seal, and the second to operate the bag [Class A; LOE Expert Consensus Opinion]" (Australian and New Zealand Committee on Resuscitation, 2016, p.2).

Level of evidence	Type of study design
I	A systematic review of level II studies
II	A randomised controlled trial
III-1	A pseudorandomised trial (i.e., alternate location or some other method)
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group
IV	Case series with either post-test or pre-test/post-test outcomes

Table 1: National Health and Medical Research Council hierarchy of evidence (National Health and Medical Research Council, 2009, p.47).

Grade	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
✓	Recommended best practice based on clinical experience and expert opinion

Table 2: National Health and Medical Research Council grades of recommendations (National Health and Medical Research Council, 2009, p.47).

Given the number of peer-reviewed articles in water competency and drowning prevention published by New Zealand-based researchers like Dr Kevin Moran and Teresa Stanley (The University of Auckland, 2019), one would think that the sector, and indeed

policymakers, funders, and government would in the first instance refer to these sources. This is not, however, always the case. The reasons for this, in the author's opinion, are due to a lack of knowledge that these publications exist, personalities and politics, and that some projects, e.g., Martin Jenkins WSNZ Review are outside the scope of expertise for 'traditional' water safety researchers or their academic institutions (Martin Jenkins, 2013). Also, in the case of Martin Jenkins, there was an existing relationship between the commissioning body (Sport New Zealand) and other government agencies for which they had undertaken previous work at the governance level.

It has been my impression of some corporate and market research organisations, though, that they may lack the ability to incorporate relevant scientific research or statistical analysis into their reports. Also, the level of evidence for specific recommendations, especially conclusions drawn from percentage changes from one year to the next may be statistically inaccurate. For example, in their report *2019 Recreational Boating Participation Research*, Griffiths et al. (2019) state that "there has been a significant decrease in the number of boaties who say they ensure there are enough lifejackets for all their passengers" (Ibid., p.49). It is unlikely that in using the term 'significant', the authors were referring to statistical significance (p-value ≤ 0.05), as used in scientific research.

There is a potential role, therefore, for practitioners with experience in public policy, market research, or governance to assist these organisations in translating academia and interpreting statistics in a manner that can better guide policy and decision-making. Another potential barrier to the inclusion of this information is how research findings are presented. The format of a journal article may not, for example, be suitable for a governmental agency looking for information to support a new injury prevention strategy or funding decision.

The ILS Medical Committee only recently identified that in respect of all their MPSs they have three target audiences: the public; lifeguards, lifeguard instructors and managers; (and) health professionals, including medical directors, doctors, paramedics, and nurses. Each audience requires the information to be presented in a slightly different way. To this end, each statement now includes a 'plain English' summary and is scheduled for an update to ensure all target audiences are catered for (International Life Saving Federation Medical Committee, 2019).

The final group in which the nature of evidence will be considered is the general public and the media. In this domain, it is either the association with an organisation considered to

be authoritative on a topic, e.g., SLSNZ, WSNZ, Drowning Prevention Auckland (DPA) or the qualifications of the writer/speaker that provides legitimacy. Given the broad reach of the audience, extra care must be taken to ensure the information provided is correct, as generally there will only be one opportunity to connect with the receiver. Printed retractions or corrections to online articles are unlikely in the author's view to undo any miscommunication that may have occurred. Language should be free of jargon, and technical aspects may have to be broken down into commonly used terms to simplify the message.

At times, the media, or individuals conducting online research purport to report technical or medical information as factual when it may not be. This often requires contacting the writer to clarify the misinformation. As expected, the response is variable. However, one area in which the author has had some success is reminding the New Zealand media to refrain from calling water-related deaths 'drownings' until the actual cause of death has been determined by the coroner (NZ Herald, 2011). Other instances of misinformation in the public domain have prompted drowning prevention agencies to create online educational resources like www.notoutofthewater.com. This website provides fully referenced medical advice in plain English to anyone concerned about delayed or secondary drowning, both of which are fictitious conditions incorrectly given authenticity by the media, and disappointingly, some health professionals (Not Out Of The Water, 2019; Pradhan, 2018).

The nature of evidence as it relates to PWDPs is that many of the outputs, especially prevention, attempt to influence the behaviour of individuals, or when these measures have failed, provide guidance on how to rescue and resuscitate a victim safely. Central to these objectives is ensuring that: evidence exists to support the recommendations; the advice is plausible and appropriate for the target audience; (and) is subject to review on a regular basis in response to end-user feedback, near-misses, and actual drowning incidents.

In Chapter 7, I consider my role as evidence translator; attempting to bridge the gap between practice and academia to integrate the traditional paradigms which separate professional and scientific knowledge. This is done to move towards a new system of evaluating evidence that is more lifeguard-centric and to make scientific knowledge easier to apply in the government, policy, media, and public domains. Considering calls from within the sector for more evidence to guide practice, the need for a bespoke system like this becomes very apparent.

Chapter 3. Methodology

In this chapter, I examine the research methodologies used to produce and critique the PWDPs submitted in this context statement. Given the variety and different applications of the works, more than one theory will be discussed. An analysis of the theoretical framework of the methodologies using an empirical science and autoethnographic approach will be used to satisfy the criteria for the award of Doctor in Professional Studies by Public Works, ensuring the context statement makes explicit:

> "What it is that links these public works and what needs to be said about them in terms of your own learning and in terms of positioning them both in your professional area of practice and in the [wider] field of knowledge" (Maguire, 2012, p.24).

Central to achieving these criteria will be an emphasis on not only how the research was conducted, but also why it was conducted, the personal motivators and influencing factors, and finally, the translation of evidence from academia to applied practice in the field.

3.1 Theoretical aspects of empirical research

Empirical research is "a way of gaining knowledge by means of direct and indirect observation or experience" (Wikipedia, 2018). Another definition offered by Adolphus (2018) is "empirical research is research that is based on observation and measurement of phenomena, as directly experienced by the researcher. The data thus gathered may be compared against a theory or hypothesis, but the results are still based on real life experience".

Empirical evidence is linked to the theory of empiricism, one branch of epistemology or the study of human knowledge. Empiricism holds central the tenet that knowledge comes from experience derived from observation through the senses, as opposed to any innate or traditional (prior-held) belief. It can, however, be linked to theory and real-world practice, and as Adolphus (Ibid.) states, "the link between research and theory is symbiotic: theory should inform research, and the findings of research should inform theory".

Several other theories inform empirical research, including positivism, interpretivism, and realism (Table 3). None of these approaches are mutually exclusive, and they can be used in combination. While none of these theories were forefront of mind at the time when I

embarked on producing public works, it is now evident how they relate to the works and can be applied to future projects.

Positivism	"Positivism adheres to the view that only 'factual' knowledge gained through observation (the senses), including measurement, is trustworthy. In positivism studies the role of the researcher is limited to data collection and interpretation in an objective way. In these types of studies, research findings are usually observable and quantifiable" (Dudovskiy, 2018).
Interpretivism	"Interpretivism [requires] researchers to interpret elements of the study, thus integrates human interest into a study" (Ibid., 2018). "Accordingly, interpretive researchers assume that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, shared meanings, and instruments" (Myers cited in Ibid., 2018).
Realism	Realism relies on the idea of independence of reality from the human mind. This philosophy is based on the assumption of a scientific approach to the development of knowledge. Realism can be divided into two groups: direct and critical" (Ibid., 2018). Direct realism, also known as naive realism, is described by Saunders, Lewis and Thornhill (cited in Ibid., 2018) as "what you see is what you get". Novikov and Novikov (cited in Ibid., 2018) state "critical realism, on the other hand, argues that humans do experience the sensations and images of the real world. According to critical realism, sensations and images of the real world can be deceptive and they usually do not portray the real world".

Table 3: Theories informing empirical research.

As Adolphus (2018) rightly asserts, "at what point in your research you bring in a theoretical perspective will depend on whether you choose an inductive approach (collect the data, then develop the theory, [or a] deductive approach (assume a theoretical position then test it against the data)". Comparing the two approaches reveals how they relate to the construct of the theory and role of the researcher in the process (Table 4).

The inductive approach	**The deductive approach**
"Is more usually linked with an interpretive approach.	"Is more usually linked with the positivist approach.
Is more likely to use qualitative methods, such as interviewing, observation etc., with a more flexible structure.	Is more likely to use quantitative methods, such as experiments, questionnaires etc., and a highly structured methodology with controls.
Does not simply look at cause and effect, but at people's perceptions of events, and the *context* of the research.	Is the more *scientific* method, concerned with cause and effect, and the relationship between variables.
Builds theory *after* collection of the data.	Starts from a theoretical perspective and develops a hypothesis which is tested against the data.
Is more likely to use an in-depth study of a smaller sample.	Is more likely to use a larger sample.
Is less likely to be concerned with generalisation (a danger is that no patterns emerge).	Is concerned with generalisation.
Stresses the researcher involvement" (Adolphus, 2018).	Stresses the independence of the researcher" (Ibid.).

Table 4: Comparison of the inductive and deductive approaches to empirical research.

Empirical research can be conducted using a variety of methods. These include experiments, surveys, case studies, ethnographic and observational methods, and grounded theory. The majority of my PWDPs have involved experimental, survey, or case study-based scientific research. Others, however, had their genesis in personal reflection on my and other team member's practice during routine operations or critical incidents in the workplace. It is of greater interest and personal benefit to me, therefore, both as a researcher and in meeting the requirements for this degree, to see how both the inductive and deductive approaches apply to the ethnographic and grounded theory methods of investigation.

These methods are especially relevant, given my current interest in human factors/ crisis management within SLS teams and improving rescuers' ability to detect drowning. A prima facie assessment suggests that these methodologies provide a valid link to the human

sciences in which both these areas of interest are vested. Running controlled experiments outside of a laboratory setting on these topics is challenging, so from a practical perspective conducting research and testing hypothesis while lifeguards are 'on the job' is one of the few ways that this data can be collected.

3.2 Autoethnography and grounded theory

Autoethnography is a research method that combines the characteristics of autobiography and ethnography (Ellis, Adams and Bochner, 2011). The method is described by Ellis (cited in Ellis, Adams and Bochner, 2011, p.1) as "an approach to research and writing that seeks to describe and systematically analyse (graphy) personal experience (auto)…to understand cultural experience (ethno)". Autobiographers are often inspired to write about meaningful life or transformative events that others may or may not regards as such.

When researchers write ethnographies, they produce what Ellis, Adams, and Bochner (Ibid.) refer to as "a thick description" of a culture to enable both insiders and outsiders to understand it better. The research is conducted inductively and attempts to discern patterns of cultural experience, be they repeated feelings, events, or situations. Autoethnographers:

> "Seek to produce aesthetic and evocative thick descriptions of personal and interpersonal experience. They accomplish this by first discerning patterns of cultural experience evidenced by field notes, interviews, and/or artefacts, and then describing these patterns using facets of storytelling (e.g., character and plot development), showing and telling, and alterations of authorial voice. Thus, the autoethnographer not only tries to make personal experience meaningful and cultural experience engaging, but also, by producing accessible texts, she or he may be able to reach wider and more diverse mass audiences that traditional research usually disregards, a move that can make personal and social change possible for more people" (Ellis, Adams and Bochner, 2011, p.4).

Several forms and approaches to autoethnography are described by Ellis, Adams, and Bochner (2011); however, the ones that resonate most closely with the methods that I have used to conduct some of my research are layered accounts and grounded theory.

Layered accounts combine the author's experience alongside available data, abstract analysis of the experience(s), and relevant literature. With this method, data collection and analysis can co-occur (Charmaz, 1983). Existing research is treated as a source of questions

and a base for comparison as opposed to a "measure of truth" (Ibid., p.117). This differs from grounded theory, where a study:

> "Is likely to begin with a question, or even just with the collection of qualitative data. As researchers review the data collected, repeated ideas, concepts or elements become apparent, and are tagged with codes, which have been extracted from the data. As more data is collected, and re-reviewed, codes can be grouped into concepts, and then into categories. These categories may become the basis for new theory. Thus, grounded theory is quite different from the traditional model of research, where the researcher chooses an existing theoretical framework, and only then collects data to show how the theory does or does not apply to the phenomenon under study" (Wikipedia, 2018).

Autoethnography is not without its detractors, however, and is criticised for being "too artful and not scientific, or too scientific and not sufficiently artful" (Ellis, Adams and Bochner, 2011, p.7). Other concerns are that it lacks scientific rigour, sufficient theoretical basis and analysis, and focuses too much on the aesthetic, emotional, and therapeutic aspects of the work (Ellis, Hooks and Keller, cited in Ibid.). Ellis, Adams, and Bochner (2011, p.7) provide the following rebuttal: "These criticisms erroneously position art and science at odds with each other, a condition that autoethnography seeks to correct. Autoethnography… attempts to disrupt the binary of science and art. Autoethnographers believe research can be rigorous, theoretical, and analytical and emotional, therapeutic, and inclusive of personal and social phenomena".

3.3 Gibbs' reflective cycle

This model of reflective practice devised by Graham Gibbs and published in his book *Learning by doing* (Gibbs, 1988) is a systematic, iterative model of learning comprised of six steps. The steps are: description; feelings; evaluation; analysis; conclusion; (and) action plan. The model was developed from Kolb's experiential learning theory (Kolb, 1984), which states that new experiences are the origin of new concepts and theories.

Gibbs' model is particularly relevant to many of my PWDPs that originated from personal and group reflection on routine and critical incidents in lifeguarding. Although Gibbs' model is particularly useful for reflecting on incidents that did not go well, it also provides a basis for system and process improvements that arise from individuals or teams identifying

better ways of doing things and from incidents that did go well. Figure 3.1 provides a graphical depiction of the model where five steps have been used instead of six (analysis is included in the evaluation phase).

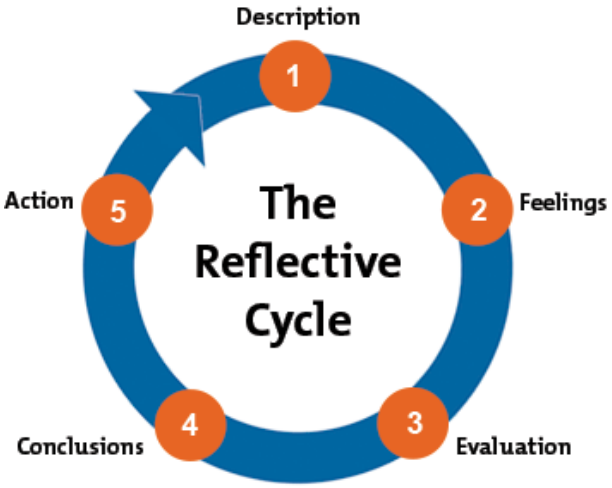

Figure 3.1: Gibbs' Reflective Cycle.
Image credit: Mind Tools.

Gibbs' reflective cycle will be used as the basis for Chapters 5, 7, 8 and 9 where my reflection on practice, professional development and learning, future impact of the works, conclusions, and recommendations for others working in the field are discussed. This review framework connects the theory of work-based research methodology to other research outputs and learning.

Having gained an understanding of theories explored in this chapter now provides me with several recognised frameworks to formulate and test new hypotheses, question existing theories or knowledge on a subject, and most importantly, critically review the public works submitted in this context statement.

Chapter 4. Public works in drowning prevention

The PWDPs submitted in this context statement are comprised of various outputs that have been organised into the following categories:

- Development of drowning prevention models and reaction mnemonics (Appendix A)
- Revision of drowning data collection and patient care guidelines (Appendix B)
- Establishment of an international drowning research organisation and national aquatic safety agency (Appendix C), and
- Scientific research in applied lifeguarding practice (Appendix D and E).

The common theme linking these works from a global perspective is drowning prevention, as it relates to the Drowning Chain of Survival and my role as a New Zealand-based lifeguard. All the PWDPs submitted have either been published in peer-reviewed journals, adopted as official guidelines, or presented at international conferences. Most of the public works have been produced in collaboration with other drowning prevention practitioners. The chapter summarises all the PWDPs submitted in fulfilment of the DProf by Public Works degree.

4.1 Development of drowning prevention models and reaction mnemonics

Three PWDPs are submitted in this section. They include the *Drowning Chain of Survival* (Szpilman et al., 2014), *Drowning Timeline* (Szpilman et al., 2016), and *4Rs of Aquatic Rescue* (Moran, Webber and Stanley, 2017).

Drowning Chain of Survival

The Drowning Chain of Survival (Figure 1.1) is a graphical response and education tool based on the Wet Chain of Survival, which was first described by Szpilman et al. (2006) in the *Handbook on Drowning*. The model aims to replicate, from a drowning perspective, the cardiac arrest Chain of Survival (Nolan, Soar and Eikeland, 2006). The cardiac arrest Chain of Survival is an established emergency response system that describes the critical elements required for a patient to survive a sudden cardiac arrest. Similarly, the Drowning Chain of Survival provides rescuers with a series of actions, that when enacted, aims to reduce death by drowning in any aquatic setting. The model attempts to mitigate the risk to rescuers, who in some cases drown while trying to save the life of another. This phenomenon has been described by Franklin and Pearn (2010) as the aquatic victim-instead-of-rescuer syndrome.

Although designed primarily as an educational tool, it can also be used as a cognitive aid during a real emergency to guide rescuers on-scene. The Drowning Chain of Survival's theoretical basis is vested in the Haddon Matrix, a commonly used framework in the injury prevention field. The Haddon Matrix considers the various influencing factors before, during, and after an incident as they relate to the host (person), equipment/vehicle, and environment. At each stage, counter-measures can be applied to eliminate or minimise the risk of serious harm or death (Haddon, 1999).

Drowning Timeline

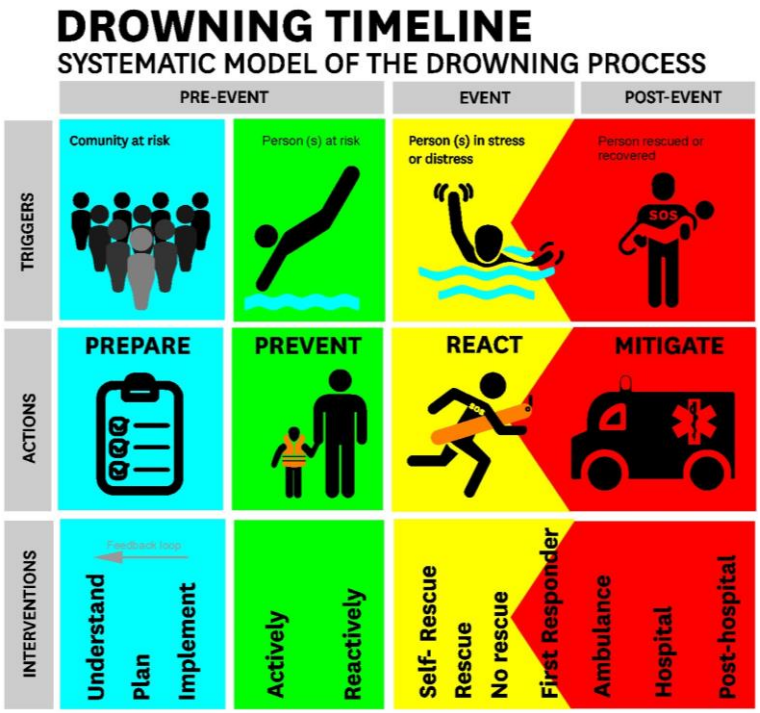

Figure 4.1: The Drowning Timeline describes the phases of the drowning process from pre-event through to post-event. The model has a strong emphasis on preventive measures to negate the need for subsequent rescue/medical care. Image credit: Sociedad Española de Medicina de Urgencia y Emergencias.

The Drowning Timeline (Figure 4.1) is the first published work of IDRA (Szpilman et al., 2016). This model has even stronger links to the Haddon Matrix than the Drowning Chain of Survival as it describes in more detail each stage of the drowning process as it relates to communities and individuals at risk, persons in stress/distress, and persons rescued or recovered. There is more of a focus on the planning and preparation phase before an incident, and the role of the community to evaluate the effectiveness of interventions using a feedback loop. The model then describes the reaction and mitigation phases that relate to a person in stress/distress

when these antidotes fail, and the post-event care that may be required.

The intent of the model was to incorporate changes to the definition and outcomes of drowning that have yet to be universally adopted, promote/encourage their use, and, as is the challenge in other forms of trauma, provide a clear distinction between the pre-event, event, and post-event phases in a chronological order to guide interventions (Szpilman et al., 2016). It is envisaged that this model will improve the quality of data collected, allowing the global problem of drowning to be better quantified and the effectiveness of prevention strategies to be measured.

The 4Rs of Aquatic Rescue

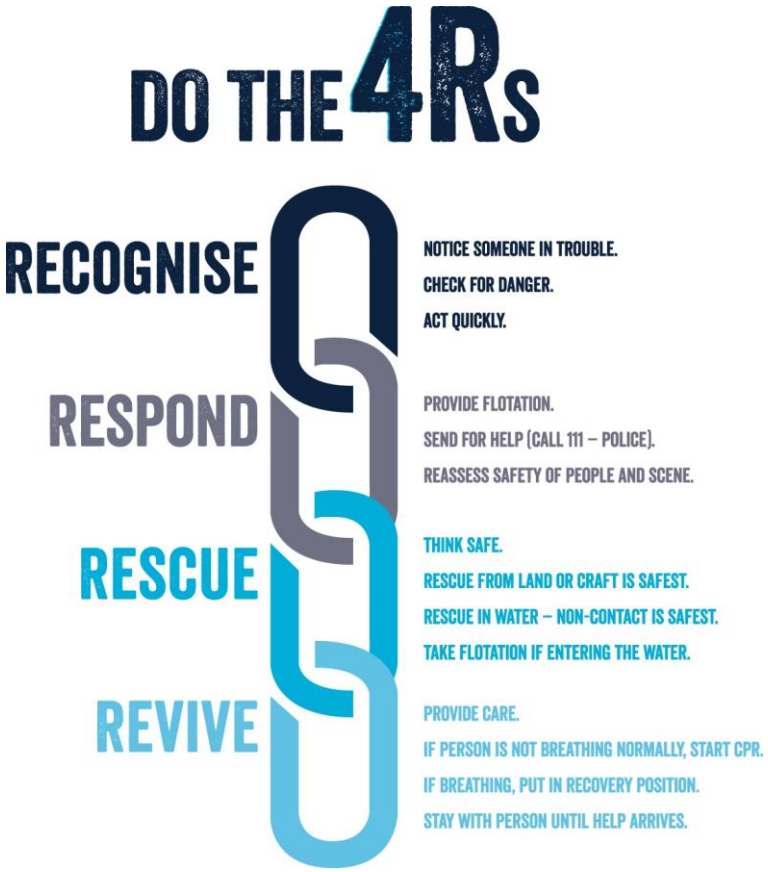

Figure 4.2: The 4Rs of Aquatic Rescue outlines the steps to be taken by the public if they see a person in trouble in the water. Image credit: Drowning Prevention Auckland.

Developed in conjunction with DPA, The 4Rs of Aquatic Rescue (Figure 4.2) is a reaction mnemonic and educational tool designed to guide the public in the steps that should be taken if a person is observed to be in distress or drowning (Moran, Webber and Stanley, 2017). The model assumes all preventative measures have failed, and immediate action is required to:

recognise a person in trouble; call for help; interrupt the drowning process by providing flotation; rescue the person from the water if safe to do so; (and) revive them with CPR if needed. It was specifically developed to address the issue of aquatic victim-instead-of-rescuer syndrome by providing bystanders with a series of steps that would maximise their safety, and at the same time, improve the victim's chance of survival. The aquatic victim-instead-of-rescuer syndrome occurs when the person who has attempted rescue becomes the victim, and in some cases, drowns (Franklin and Pearn, 2010).

4.2 Revision of drowning data collection and patient care guidelines

The PWDPs submitted in this category are the *2015 Revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation* (Idris et al., 2017) and *Guideline 9.3.2 – Resuscitation of the drowning victim* (Australia and New Zealand Committee on Resuscitation, 2014).

2015 Revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation

In 2003, the International Liaison Committee on Resuscitation (ILCOR) published guidelines for the collection of data from drowning resuscitation, and a uniform definition of drowning and drowning outcomes (Idris et al., 2003). This data could then be used to guide future drowning prevention strategies and interventions. These definitions were then endorsed by the WHO (World Health Organization, 2019).

The purpose of the guideline was to provide uniformity and specify what core and supplementary data should be collected from drowning resuscitation incidents. Like the original Utstein-style template for cardiac arrest (Cummins et al., 1991), the goal of these guidelines was to improve comparability of future scientific and epidemiological reports as over 30 terms have historically been used to describe drowning and its outcomes (Papa, Hoelle and Idris, 2005).

In 2013, the Second International Utstein-Style Consensus Conference on Drowning was convened in Potsdam. This group was comprised of scientists, representatives from resuscitation councils, and international experts in drowning. The group examined each of original template's data elements to see if they were still relevant, or if other alternatives should be considered. Following two rounds of a Delphi consensus process and face-to-face

discussion at the conference, over the following two years, an updated template was produced. The *2015 Revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation* was eventually published as an ILCOR advisory statement (Idris et al., 2017).

Guideline 9.3.2 – Resuscitation of the drowning victim

ANZCOR represents Australia and New Zealand on ILCOR, the organisation responsible for publishing global consensus on science treatment recommendations in resuscitation and first aid. Guideline 9.3.2 provides an overview of the drowning process and the initial management of a drowning patient. Member organisations of ANZCOR and education providers in both countries follow this guideline when teaching first aid to the public, first responders, and health professionals.

The guideline aims to ensure patients receive the best, evidence-based care, and to remove confusion caused by training providers using dated or non-scientifically validated treatment recommendations. It was reviewed in 2013, and an updated version published in 2014. This update included a significant change in practice for Australia, where up until this point all drowning casualties were routinely assessed on their side. All ANZCOR guidelines are regularly reviewed, and this guideline is now due for an update as part of the organisation's continuous evidence evaluation process.

4.3 Establishment of an international drowning research organisation and national aquatic safety agency

Two PWDPs are presented in this section. *Establishment of the International Drowning Researchers' Alliance* (Queiroga et al., 2015) and *Establishment of coastal lifeguard services in Pakistan* (Webber, 2007).

Establishment of the International Drowning Researchers' Alliance

IDRA was established during a meeting in Balbriggan of drowning prevention researchers, lifeguards, and medical practitioners at the 2014 Lifesaving Foundation Drowning Prevention and Rescue Conference. IDRA is described as "an international scientific network devoted to all aspects of the use of quantitative and technical methods in drowning research to promote safety in and around water environments" (International Drowning Researchers' Alliance, 2018). The stated goals of IDRA are: to provide an international platform for collaborative

research efforts in global drowning prevention; to act as a repository for drowning research; to work with government agencies and drowning prevention agencies to foster best practice in data collection and research; (and) to provide technical assistance and mentoring to new and existing drowning prevention researchers (Ibid.).

IDRA is comprised of its foundation, invited honorary, affiliated, and collaborating members. Members are connected via an electronic workspace and meet every two years at the WCDP. IDRA has also published several articles and letters to the editor related to drowning nomenclature (Webber et al., 2017a, 2017b; Venema et al., 2018; Queiroga et al., 2018; Szpilman et al., 2018).

Establishment of coastal lifeguard services in Pakistan

Figure 4.3: Qualified professional ocean lifeguards from Pakistan Life Saving, trained and equipped by Surf Life Saving Northern Region. Photo credit: Jonathon Webber.

In 2004, SLSNR agreed to assist Pakistan Life Saving (PALS) establish lifeguard services on the coastline of Karachi, which extends some 40 km along the southern border of Pakistan on the Arabian Sea. Over two million people visit these beaches every year, with an annual drowning toll, before 2004, of >250 (Pakistan Aquatic Life Saving, 2016). Before the establishment of PALS, City District Government of Karachi (CDGK) lifeguards were employed; however, the only service they provided was body recovery.

The aid provided by SLSNR comprised of a training delegation to instruct and qualify recruits as surf lifeguards and provision of patrolling equipment including uniforms, rescue

tubes, rescue boards, first aid supplies, resuscitation manikins, beach flags, and an inflatable rescue boat, all donated by SLSNR clubs (Figure 4.3). The training delegation qualified 150 recruits to New Zealand surf lifeguard award or SLS certificate standard. Additional training delegations have been undertaken since the first team visited in 2004, the most recent taking place in 2016 (Swannix, 2016). These missions have focused on conducting refresher training, running the inaugural surf sports competition, assisting with sponsorship proposals, and qualifying selected senior lifeguards as instructors. Ongoing remote support and advice are still provided to the present day.

4.4 Scientific research in applied lifeguarding practice

A selection from over 40 articles, abstracts, and chapters published in peer-reviewed scientific journals, conference proceedings, and textbooks are summarised in this section (See also: https://www.researchgate.net/profile/Jonathon_Webber/research). These works relate to applied lifeguarding practice in the fields of: airway management in drowning (Baker and Webber, 2011, 2014; Hood and Webber, 2014); first aid facilities at beaches and training for lifeguards (Queiroga and Webber, 2014; Szpilman et al., 2014); surf lifeguard perception and performance of CPR (Moran and Webber, 2012, 2013a; Webber, Moran and Cumin, 2019); leisure-related injuries at the beach (Moran and Webber, 2013b, 2013c, 2013d); (and) drowning definitions (Jones, Moran and Webber, 2013; Szpilman et al., 2018).

The Sentinel System for Response to Drowning (Figure 4.4) was developed as an educational tool for use by lifeguards and is designed to improve detection rates and response times to distress/drowning incidents, provide a layered response-matrix based on the patient's threat to life, and outline a framework for patient assessment, treatment and discharge from care (Doyle and Webber, 2007). Sentinel trains lifeguards to triage victims in-water and always invokes a response, so at the very least, any potential victims are checked on or moved away from the hazard.

The patient status codes are based on the Australasian Triage Scale, as used by hospital emergency departments (New Zealand Ministry of Health, 2018), and the colours mirror the response levels and patient status codes used by the ambulance service in New Zealand (St John, 2016). Patient assessment and treatment are based on a simplified version of the Drowning Classification System, which differs from the Brazilian system where patients

are graded from one to six, with six being the most severe category (Szpilman, 1997). Figure 4.4 depicts the summary matrix of the model, however, separate tables feature in the full system that cover drowning detection, levels of response, and training required to respond to and treat a patient at each of the status levels (Appendix E).

SENTINEL SYSTEM FOR RESPONSE TO DROWNING					
STATUS	**ONE**	**TWO**	**THREE**	**FOUR**	**FIVE**
Threat to Life	IMMEDIATE	CRITICAL	SERIOUS	MODERATE	LOW
Behaviour Displayed	Submerged or Unconscious	Instinctive Drowning Response	Distress	Early Distress	No Distress (Hazard Present)
Response Required	Urgent Rescue (multi-level) Buoyancy Support + / - in-water BLS Call for Ambulance	Urgent Rescue Buoyancy Support Rescue Assets on standby	Immediate Rescue Buoyancy Support (if required)	Routine or Immediate Rescue	Preventative Action or Routine Rescue
Patient Assessment	Unresponsive and not breathing normally	Large amount of foam in mouth or nose; breathing inadequate or decreased LOC	Large amount of foam in mouth or nose; breathing adequate	Small amount of foam in mouth or nose; lung sounds abnormal	Cough, with no foam in mouth or nose; lung sounds normal
Treatment	Start CPR Bag/mask with high-flow oxygen Attach AED	High-flow oxygen Monitor breathing Vital signs Recovery position	High-flow oxygen Vital signs Recovery position	Oxygen Warm and calm the victim Recovery position	Rest, warm and calm the victim Oxygen not normally required
STATUS FIVE PATIENTS WITH NO OTHER MEDICAL PROBLEMS OR INJURIES CAN BE DISCHARGED INTO THE CARE OF A RESPONSIBLE ADULT. CALL AN AMBULANCE FOR ALL OTHER PATIENTS					

Figure 4.4: The Sentinel System for Response to Drowning is a triage matrix designed to provide the right response, to the right patient in the right amount of time. The colour/status codes correlate to those used by emergency departments and ambulance services throughout New Zealand.

Chapter 5. Critical review of the public works

In this chapter, a critical review of the public works that links and positions them in my fields of professional practice (i.e., their contextual nature), and the wider bodies of knowledge in lifeguarding and drowning prevention is presented. How this was achieved from a conceptual and theoretical basis is discussed, along with an exploration of:

- My involvement in the production of the works
- The transdisciplinary approach, MDTs, and communication strategies used in creating the works, and
- Selected examples that demonstrate the regional, national, and international impact of the works.

5.1 Contextual nature of the works and relevance to existing bodies of knowledge

In Chapter 1, the influencing factors and core themes informing the context statement were considered. Some of these influences and themes will be referred to in this section also as they are relevant to the positioning of the PWDPs against existing bodies of knowledge, and in assessing their practical application and utility. The theoretical framework for this critique will be the Drowning Chain of Survival, for which the major advice actions of each of the links of the chain are described in Table 5. This model resonates with me not only because it has been developed from a lifeguarding perspective, but also due to its simplicity and use of visual messaging. It describes in general terms the pre-event, during event, and post-event actions associated with a drowning incident.

Similar advice actions can be found in other guidelines; for example, the International Task Force on Open Water Drowning Prevention's 16 safety messages (Moran et al., 2011). In comparison to the Drowning Chain of Survival, however, only two of these messages relate to rescue and resuscitation; the others relate to prevention, which is the most critical intervention. The messaging is consistent, though, and it is the author's opinion that this has resulted in less conflicting advice and improved water safety messaging from the sector to the general public and other audiences.

Relevant also to contextualising the PWDPs are several key meetings and publications. The first World Congress on Drowning, held in 2002, was a landmark gathering for drowning…

Link	Major Advice Actions
	• "Stay within arm's reach of children when in or near the water • Swim in water-safe areas where there are lifeguards • Fence pools, spas and other aquatic locations with 4-sided fencing • Always wear a lifejacket when using watercraft • Learn how to swim and water safety survival skills
	• Recognise early drowning victim's distress signs. Victims may not wave or call for help • Tell someone to call for help while staying on-scene to provide assistance • Watch where the victim is in the water, or ask a bystander to keep constant watch
	**While helping others** • Stay out of the water to reduce rescuer-risk • Throw something that floats to the victim **To help yourself** • If you are in difficulty, don't panic; stay with any flotation you may have • Signal for help as soon as possible, and float
	• Assist the victim on how to self-rescue by giving them directions for getting out of the water • Try to remove the victim without entering the water • Only if safe to do so, rescue the victim using any flotation available
	• If not breathing, start CPR (ventilations and compressions) immediately • Consider the use of oxygen and an automated external defibrillator (AED) as soon as possible if available • If breathing, stay with victim until help arrives • Seek medical aid/hospital if any symptoms are present, and for all victims who require resuscitation" (Szpilman et al., 2014, pp.1150-1151).

Table 5: Major advice actions in the Drowning Chain of Survival.

…prevention worldwide. This event is regarded as the genesis for the WCDP; the premier

event for disseminating drowning prevention and applied lifeguarding practice research. This conference sees many of the world's foremost experts on drowning prevention assemble in one place and provides an essential forum for PWDPs to be presented and critiqued. Most of the PWDPs submitted in this context statement have been presented at these events.

Following the 2002 meeting, Dr Joost Bierens, on behalf of Maatschappij tot Redding van Drenkelingen (Society for the Saving of Drowning Victims) embarked on a project of international significance; the production of the *Handbook on Drowning* (Bierens, 2006). This edited textbook, comprised of 304 chapters covering virtually every aspect of drowning, marked a 'coming of age' for the sector as for the first time all available scientific evidence was compiled in a single resource. This was followed by a review article on drowning in *The New England Journal of Medicine* by Szpilman et al. (2012). The article covered all aspects of drowning pathophysiology, resuscitation, and in-hospital treatment. It has been cited 156 times (Scopus, 2020) and given significant exposure to drowning.

These forums, and landmark publications, have contributed enormously to position drowning as a specialised branch of injury prevention and resuscitation. More importantly, from a personal standpoint, they have provided a reference point for the PWDPs that I have been involved in producing, and motivation to build on the existing bodies of knowledge, especially in areas where there is a lack of scientific evidence. To contextualise this, a timeline of the global socio-political perspectives as they relate to my evolving roles professionally, production of the PWDPs and involvement with important events in the sector is presented in Figure 5.1 (Couldrey, 2020). The diagram aims to serve as a navigational aid for the context statement that summarises my past, present, and future sector involvement.

Drowning prevention models and reaction mnemonics

The Drowning Chain of Survival (Figure 1.1) was updated to represent a shift away from the medical slant of the previous model, the Wet Chain of Survival (Szpilman et al., 2006), and give greater attention to the water-rescue aspects of a drowning incident; maximising the victim's chance of survival and minimising the risk to rescuers when executing a rescue. I proposed an update of the model in a presentation made at the 2012 Lifesaving Foundation Drowning Prevention and Rescue Conference in Dublin (Webber, 2012). The changes were in response to: a perceived sector inability to recognise the provision of flotation as a crucial tactical goal in water-rescue situations; failure to address the number of would-be rescuers…

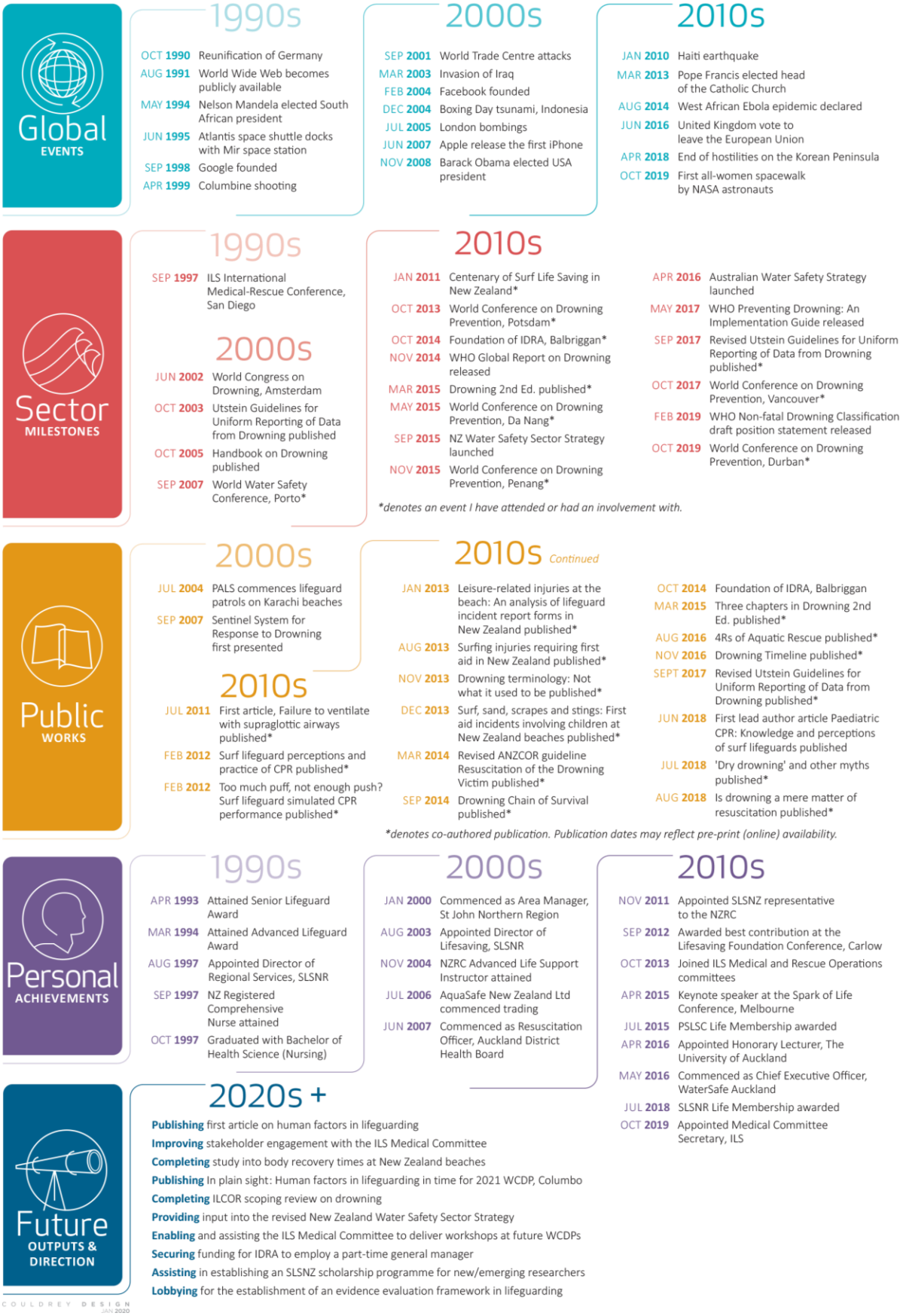

Figure 5.1: Timeline of key socio-political events, sector milestones, author's achievements, and future output and direction as they relate to the production of public works in drowning prevention submitted in this context statement. Image credit: Couldrey (2020).

…drowning while attempting rescue; (and) unwillingness of the media and rescue agencies to provide the public with information on what they should do if they see a person in trouble in the water. It was my belief also that the Wet Chain of Survival replicated elements already covered in the cardiac arrest Chain of Survival.

A major theme of my presentation in Dublin was buoyancy support; a key strategy in water-rescue that interrupts the drowning process and prevents submersion by providing flotation (Ibid.). Providing flotation is the central, and most crucial link in the Drowning Chain of Survival after prevention (the first link in the chain). The importance of providing flotation to a drowning person in lifeguarding has been described by Pia (1974), however despite being re-defined in the Sentinel System for Response to Drowning by Doyle and Webber (2007) as buoyancy support; the phrase used to describe the strategy to prevent victim submersion, it had not achieved industry-wide acceptance or practical application. The reasons for this are not fully understood, but the fact Sentinel has not been formally validated or published, in the author's opinion, is a contributing factor.

Another issue is that in lifeguard training, a rescue in simple terms involves removing the victim from the water. Information on priorities in drowning is limited, and the concepts of providing flotation to interrupt the drowning process or a non-urgent rescue are not widely taught or understood. For example, the SLSNZ *Surf Lifeguard Training Manual 2019* does not refer to the use of flotation to interrupt the drowning process or in situations where immediate rescue is not possible (Surf Life Saving New Zealand, 2019). The adoption of the Drowning Chain of Survival by ILS, the ERC and NZRC, and promotion by SLSNZ, however, at least provided some high-level endorsement needed to ensure the model and its central themes had at least been subjected to the scrutiny of expert opinion before being released in the public domain.

The 4Rs of Aquatic Rescue (Figure 4.2) is a reaction mnemonic co-developed by me in response to the number of rescuer fatalities in New Zealand and growing public concern about these preventable deaths (Moran, 2013). The model builds on several well-established educational tools including 'Shout-Reach-Throw-Row-Go-Tow' (Royal Life Saving Society Canada, cited in Moran, Webber and Stanley, 2017, p.2), and 'Check-Talk-Reach-Throw-Wade-Row' (Royal Life Saving Society Australia, cited in Moran, Webber and Stanley, 2017, p.2). It specifically addresses the fifth recommendation of the WHO's implementation guide for drowning prevention to "train bystanders in safe rescue and resuscitation" (World Health

Organization, 2017, p.47). The model has similarities to the Drowning Chain of Survival but differs in that there are more advice actions on scene and rescuer safety, and more attention is given to the rescue and resuscitation aspects. The model specifically addresses what to do (as opposed to what not to do) when a person is observed in trouble in the water. The implicit assumption is that prevention measures have failed, making the goal of 4Rs system twofold; to save the life of the victim, and, any person(s) who enters the water to render assistance.

And finally, the most recent drowning prevention model co-produced by me is the Drowning Timeline (Figure 4.1). This high-level, strategic framework represents an update of the chronological stages of the drowning process combined into a single recognisable injury prevention model. There is a stronger emphasis on the community and individual safety measures that should be in place, and this reflects a sector-wide paradigm shift from a reactive and mitigation approach to a preventative one (World Health Organization, 2017). The model is positioned as a pre-emptive framework for countries, regions, and communities in the process of developing their water safety plans or seeking to review existing ones. As an original concept, this public work is also positioned as a new resource for central or local government, public safety, and lifeguarding agencies to refer to during policy development.

Drowning data collection and patient care guidelines

In 2013, the Second International Utstein-Style Consensus Conference on Drowning took place to review and update the ILCOR position statement *Recommended guidelines for uniform reporting of data from drowning: the "Utstein style"*. I was a member of the working group charged with undertaking this task. ILCOR published the original guideline in 2003. The purpose of this update was to confirm that all data fields were still relevant and include any new fields that the working group considered would add to the body of knowledge in drowning resuscitation. ILCOR's stated objectives are to:

1. "Provide a forum for discussion and…coordination of all aspects of cardiopulmonary and cerebral resuscitation worldwide
2. Foster scientific research in areas of resuscitation where there is a lack of data or where there is controversy
3. Disseminate information on training and education in resuscitation
4. Provide a mechanism for collecting, reviewing and sharing international scientific data on resuscitation, [and]
5. Produce statements on specific issues related to resuscitation that reflect international consensus" (International Liaison Committee on Resuscitation, 2018).

The project aligned explicitly with goals two and four. The revised guideline "deleted some items that were listed in the [previous] edition because the items were considered to be unreliable, difficult to capture, or had some other problem. Additionally, some data items were changed from core to supplementary or the other way around" (Idris et al., 2017, pp.149-150). The updated guideline shifted some of the emphasis from in-hospital to pre-hospital and includes additional data fields on scene information, critical time intervals, and CPR quality. One issue that was not addressed, however, was how to improve the quality of data collection in LMICs. This question remains largely unanswered; however, organisations like the CDC have been working in countries such as Uganda to understand the issues better, and ultimately, to improve data collection and reduce drowning (Clemens et al., 2019).

Guideline 9.3.2 – Resuscitation of the drowning victim was updated in 2014 and is one of the first statements jointly published by the NZRC and Australian Resuscitation Council under the combined banner of ANZCOR. Before this, both countries had their own guidelines. While the NZRC had been publishing resuscitation guidelines since 1996, and information on what to do for specific emergencies including drowning featured in reference textbooks, unlike Australia, there were no guidelines for first aid (McKenzie et al., 2018). The American Heart Association and ERC both publish limited first aid information in the special circumstances section of their guidelines. The number of conditions covered by ANZCOR, however, is the most extensive available (Australian Resuscitation Council, 2018).

Establishment of an international drowning research organisation and national aquatic safety agency

The foundation members of IDRA (Ana Catarina Queiroga, David Szpilman, Joost Bierens, Mike Tipton, Justin Sempsrott, Roberto Barcala-Furelos and me) created the organisation as an independent, collaborative forum for researchers worldwide involved in all aspects of drowning prevention (International Drowning Researchers' Alliance, 2018). The alliance was set up with no affiliation to any university or lifesaving agency. This was done to ensure that membership would not be restricted by geopolitical, employer, or member organisation-related constraints. While some water safety agencies have a research division, very few academic institutions have a department that focuses solely on drowning prevention. For example, my 'home' at The University of Auckland is the Department of Anaesthesiology.

For many researchers, this lack of specialist oversight and the ability to source subject-

matter experts locally can create barriers. Opportunities for postgraduate study may also be limited due to insufficient supervisory staff at masters or doctoral level. Another barrier that IDRA wants to help overcome is language. With English the global language of science (Drubin and Kellogg, 2012), the provision of native-language speaking experts to assist with reviewing manuscripts/research proposals, coordinating multicentre studies, and delivering emerging researcher workshops have allowed IDRA to offer a unique range of services to the drowning prevention community. IDRA's ability to do this, however, is constrained by the fact it has no income stream. All costs, therefore, including time spent on IDRA matters and travel are covered by the host, the members themselves, or their employer.

PALS was formed in 2004 by local businessman Reza Samad in response to the high number of drownings along the coastline of Karachi (approximately 250 per annum). Reza almost lost his life to drowning himself while attempting to rescue two friends in rough conditions. It was this ordeal that prompted him to do something about it and establish PALS (PALS Rescue, 2018). Like other LMICs, essential rescue and emergency services are often under-resourced in terms of personnel, training, access to specialist advice, and equipment.

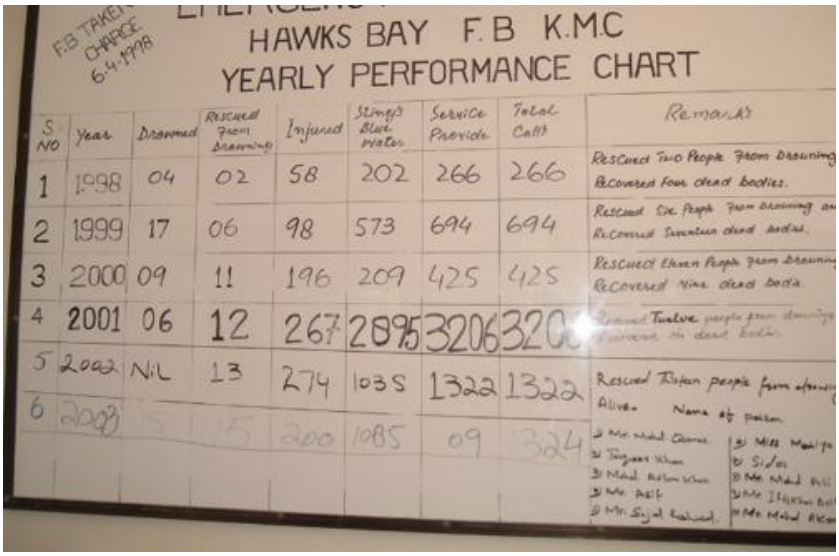

Figure 5.2: City District Government Karachi's Emergency Rescue Centre 1998-2003 drowning statistics. Photo credit: Tim Jago.

The actual number of drowning incidents is often under-reported (World Health Organization, 2014), and this makes quantifying the real social and economic cost of drowning problematic (Figure 5.2). Before PALS, the response provided by the CDGK lifeguards was a body-recovery service. This was in stark contrast to the vision Reza had; to provide lifeguard patrols at

popular locations and rescue people before they drowned.

The second goal of PALS was to "alleviate poverty by training and employing people from the poor and impoverished coastal communities across the country…[giving] the local community employment opportunities and…[a] qualification that they can use to [gain] employment as lifeguards locally…and hotels internationally" (PALS Rescue, 2018). In this regard, the dual vision for PALS is unique. Realising this would only be achieved with help from a country with an established lifeguard service, Reza asked the international community for help. Only one offer of assistance was received: from SLSNR's Chief Executive, Robert Barnes, in Auckland, New Zealand.

Scientific research in applied lifeguarding practice

The public works submitted in applied lifeguarding practice all describe original scientific research. Publications such as *Surfing injuries requiring first aid in New Zealand, 2007-2012* and *Too much puff, not enough push? Surf lifeguard simulated CPR performance* added to the existing body of knowledge, whereas others, like *Failure to ventilate with supraglottic airways after drowning* and *Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards* describe previously unreported findings. *Sentinel – A systematic approach to the early recognition of drowning: The right response, to the right victim, at the right time* is both an original piece of work, but also incorporates other recognised models and systems. Invitations to contribute to *Drowning* (Bierens, 2014) marked not only an opportunity to input into the industry's authoritative reference textbook but also international recognition as a subject-matter expert.

Three studies by the author (Moran and Webber, 2013a, 2013b, 2013c) on beach, paediatric, and surfing injuries provided one of the first retrospective case-series describing first aid treatments by lifeguards on a national scale. Before this, most data were limited to either just one location/region (Grenfell and Ross, 1992), hospitalisations (Yamamoto et al., 1992), or during competitive surfing events (Nathanson et al., 2007). The case report in 2011 of an unsuccessful use of an i-gel® supraglottic airway device in drowning (Baker and Webber, 2011) was not only a world-first in terms of this device being used on a drowning victim but also an example of a negative-result publication. Studies with positive findings feature in far greater numbers than those with negative results, producing what is known as a publication bias (Mlinarić, Horvat and Šupak Smolčić, 2017). Supraglottic airways have in recent years

been promoted as a resuscitation device highly suited to use in the pre-hospital setting (LMA North America Inc., n.d.). Their efficacy in drowning, however, has yet to be established.

Given the relative infrequency of drowning incidents requiring resuscitation (one in every 617,142 beach attendances) [Szpilman et al., 2018], it is difficult to conduct prospective research on actual patients, hence why most studies of surf lifeguard CPR are manikin-based. A further three studies by the author (Moran and Webber, 2012; 2013; Webber, Moran and Cumin, 2019) added to the scant literature (Fenner et al., 1995) on lifeguard perception and practice of CPR. In the case of the paediatric CPR study (Ibid.), all previous studies had involved either health professionals or lay rescuers and not surf lifeguards (Arshid, Lo and Reynolds, 2009; Naim et al., 2017). This was also the first study to look specifically at paediatric resuscitation in a lifeguarding context and required specialised modification to the data collection equipment (Ibid.). The main finding was that chest compressions delivered were below the ANZCOR recommended depth of 5 cm (Australia and New Zealand Committee on Resuscitation, 2016).

The Sentinel System for Response to Drowning (Figure 4.4) combined for the first time all aspects of the lifeguard-response to drowning from: identifying a person in distress or drowning; (and) triaging multiple victims in the water and levels of response depending on the urgency of the situation; through to triage and emergency care on-shore, supported by a training/skills matrix at each phase of the response (Appendix E). Although this may sound complex, the model intended to make it easier for lifeguards to decide on the type of response required, while including the option of a non-urgent rescue. For many lifeguards, 'non-urgent rescue' would seem a contradiction in terms. Before Sentinel, this concept was, and probably still is an anathema, yet other emergency services routinely despatch resources at normal road speed. I have personally seen high-speed responses by lifeguards in powered surf rescue craft that resulted in serious-harm injuries when the victim's threat to life was low. Whether Sentinel improves the type of response or makes decision-making easier for lifeguards has yet to be evaluated in practice, and is, therefore, a limitation of the model.

Sentinel was founded on several well-established systems already in use by lifeguards, ambulance services, and hospitals worldwide (Pia, 1974; New Zealand Ministry of Health, 2018; Szpilman, 1997). Like other triage systems, it aims to ensure the person(s) with the greatest threat to life are attended to first. In mass-rescue situations, it has been the author's experience that some lifeguards may initially rescue a person with a lower threat to life

and potentially compromise other victims' chance of survival. Sentinel was the system that reintroduced the concept of buoyancy support or providing emergency flotation to a victim (to prevent submersion), before removing them from the water. Once the patient is on shore, they can be categorised based on their clinical signs and symptoms. Sentinel then advises what medical treatment is required. These recommendations are based on a dataset of over 45,000 ocean rescues in Brazil, where the outcome from 2,761 drowning cases was studied (Szpilman et al., 2002). One limitation of this study, however, is that patients were assessed in Drowning Resuscitation Centres, which are staffed by doctors. A possible confounder here is the lower risk of misdiagnosis given the higher level of clinical assessment skills that a doctor typically has compared to a lifeguard.

5.2 Personal involvement in the production of public works

The purpose of this section is to outline my involvement across a selection of public works submitted in this context statement. The discussion is limited to the tasks I performed in creating the PWDPs. How the works were created, and the processes involved as part of an MDT, is covered in the next section.

Drowning prevention models and reaction mnemonics

My role in creating the Drowning Chain of Survival (Figure 1.1) was co-lead author. In this role, I shared oversight of the project from concept-stage through to publication with Dr David Szpilman. Initially, we identified and convened the writing group based on their subject-matter expertise and invited them to participate in the project. Next, a Delphi process was used to agree on the names/descriptors of the five links of the chain. I was responsible for writing the piece entitled 'Provide flotation – To prevent submersion'; the third link of the chain. The critical advice actions I developed for this link are shown in Table 5. I also provided input into the graphic design of the chain, which as a group we regarded as the most critical aspect of the model and the part that would have the most utility.

To provide some validation and feedback on the proposed model, an open workshop for delegates of the WCDP in Potsdam was held. My role was to speak to the third link of the chain, facilitate a break-out discussion group, and along with the project team, receive and respond to feedback. The responses from this workshop were then collated and circulated to the project team for review. The last stage of the project was the write-up of the model for

publication in a journal. I was involved in revising the various iterations of the manuscript, providing feedback to co-authors, and responding to questions from the journal reviewers. Once published, I presented the model at various conferences (Webber et al., 2014, 2015; Webber, 2014, 2015) and coordinated the international media release with the University of Auckland's Media and Communications Advisor (Scoop, 2014; Surfrescuenz, 2017).

With the 4Rs of Aquatic Rescue (Figure 4.2), my role was similar to that in producing the Drowning Chain of Survival, with the key difference being a smaller project team. In this case, myself (co-author), Dr Kevin Moran (lead author), and Teresa Stanley (co-author). I played a significant role in conceptualising the individual 'Rs' of the model and working with the project team to develop the supporting action statements at each step. This involved ensuring the work was original, and not just a reproduction of the Drowning Chain of Survival. I also provided feedback on the graphics that feature in the quick reference card (WaterSafe Auckland Incorporated, 2015) that is distributed at public events and education sessions.

In addition to the graphic, we were also able to pilot the model using a test-retest experimental design to determine if the model could improve participants in a water safety programme's knowledge and attitudes towards bystander rescue. The results of this study, which showed a statistically significant improvement in the knowledge-recall of the correct order of the 4Rs and related responses were published in an article entitled *The 4Rs of Aquatic Rescue: educating the public about safety and risks of bystander rescue* (Moran, Webber and Stanley, 2016). My role in this process was contributing to the writing of the manuscript, providing feedback to my co-authors on their contributions, and responding to queries from the reviewers during the publication process.

For the Drowning Timeline, I was a co-author of a letter to the *American Journal of Emergency Medicine*, where this model was published (Szpilman et al., 2016). In this role, I was responsible for contributing to the manuscript as a co-author and developing the graphic, which was refined by the writing team submitting feedback and reaching a consensus on the final design. Like the Drowning Chain of Survival, this was considered the most critical aspect of the model. A revised version of the graphic (Figure 4.1) was developed by the Sociedad Española de Medicina de Urgencia y Emergencias and now supersedes the original design.

Drowning data collection and patient care guidelines

In preparing the *2015 Revised Utstein-style recommended guidelines for uniform reporting of*

data from drowning-related resuscitation, the first role I undertook was as a participant in the Second International Utstein-style Consensus Conference on Drowning held in Potsdam in 2013. I was invited to provide input from an operational-lifeguarding perspective into the Pre-hospital Data Review Group. This was one of three review groups; the other two being Quality of Resuscitation and In-hospital and Outcome Data. Most of the invited experts were from a medical, in-hospital, or academic background, so my function was to make sure that the final product was relevant to practitioners in the field.

Before the conference, two Delphi rounds were conducted where I had to identify if each data element should be core or supplementary, provide a rating of the data element's importance to research, and suggest alternatives or additions to the existing dataset. These responses were then collated and circulated to all participants. During a series of facilitated workshops held during the Potsdam conference, I then had to critique all the data elements, not just those related to my assigned review group. The consensus review process continued through 2014 and into 2015, and during this time my role was providing input into the final version of the revised guideline that was jointly published as an ILCOR advisory statement by the American Heart Association and ERC (Idris et al., 2017).

ANZCOR review their guidelines using both a continuous evidence evaluation and cyclic process of updating them. My role was to assist the lead reviewer during a scheduled update of *Guideline 9.3.2 – Resuscitation of the drowning victim*. The starting point for the review was to evaluate the existing guideline. Recommendations from recent publications, other expert bodies, e.g., ILS and practitioners, along with differences in practice between New Zealand and Australia had to be incorporated into the revision. I was responsible for presenting and explaining the New Zealand variances in practice, as well as providing an expert opinion based on the many cases of drowning that I have been involved with during my career. In conjunction with the lead reviewer, I provided input into the re-write of the guideline that was then presented to ANZCOR for final approval.

Establishment of an international drowning research organisation and national aquatic safety agency

IDRA was the brainchild of Dr David Szpilman and Dr Ana Catarina Queiroga. I was asked to join the organisation as a founding member. In this role, I have acted in the capacity of director, along with my fellow founding members (International Drowning Researchers'

Alliance, 2018). I have been involved in completing the routine administrative tasks of any new membership-based organisation such as setting the vision, mission and strategic plan, reviewing and writing website content, selecting invited members, assessing membership applications, and other general duties. Completing these tasks has involved attending meetings in Dublin, Penang, Vancouver, Pontevedra, and Durban as well as taking part in regular teleconferences and email discussions.

IDRA has also run workshops for new and emerging researchers. I was part of the team that delivered these at three conferences and meetings. In 2019, IDRA was incorporated as a registered charity in Idaho, USA. This involved writing articles of incorporation and terms of reference. I provided input into these documents, and for the purpose of incorporation, I am listed as the president. IDRA has applied for funding to cover the cost of employing a part-time executive officer. I played a significant role in writing the prospectus that is now used in all such applications for financial assistance or sponsorship. At the 2019 WCDP in Durban, IDRA conferred its first Young Researcher Award to recognise the efforts of an individual that has made a stand-out contribution to drowning research.

My involvement in establishing PALS was through organising and participating in an initial training delegation in 2004, assisting with sourcing donations of lifeguard uniforms and equipment to take to Pakistan, and ongoing professional advice in my capacity as Senior Advisor (Lifesaving). This involvement took place when I was Director of Lifesaving for SLSNR. Along with the team manager, I assisted with the planning of the trip, selection of team members and assigning roles, setting the training schedule, and delivering the on-site education and assessments. In 2006, I returned by myself to conduct refresher training and attend meetings with local officials and potential sponsors. I have also represented PALS at ILS meetings and presented on establishing coastal lifeguard services in Pakistan at the World Water Safety conference in Porto (Webber, 2007).

Scientific research in applied lifeguarding practice

In the area of research into applied lifeguarding practice, my role has been as lead author or co-author. In these roles, I have been responsible either solely or jointly for all stages of the research and publication process. The tasks involved have included:

- Scoping the project and developing the research question
- Inviting suitably qualified co-authors to join the project team and providing oversight

of them in their respective roles

- Liaising with the organisation responsible for the paid or volunteer staff being studied to request permission to conduct the study or access their data
- Liaising with equipment suppliers when specialised research tools are required
- Submitting or reviewing ethics applications
- Recruiting, selecting, and training field research staff
- Sorting, entering, and cleaning raw data
- Writing a specific part of the manuscript, reviewing the contributions of other authors, or having overall editorial control
- Selecting a suitable journal for publication, submitting the manuscript, and responding to feedback from the reviewers, and
- Publicising the findings to interested parties once the manuscript is published.

Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards is an example of a PWDP where I performed all these tasks as lead-author. The research question originated from discussions between Dr Kevin Moran and me around the lack of research into surf lifeguards' abilities in child CPR. We intended to repeat elements of our two previous studies on adult CPR (Moran and Webber, 2012; 2013). The purpose of the study was to:

> "Conduct a comprehensive analysis of surf lifeguards' real and perceived ability regarding paediatric CPR, knowledge of child resuscitation protocols and technical competency during a simulated CPR scenario" (Webber, Moran and Cumin, 2019, p.157).

Once we agreed on the study design, I applied for ethics permission to conduct the study, and when approved, sought authorisation from SLSNR's chief executive to undertake research on any lifeguards that wanted to participate. I also made a presentation to club delegates and at the paid lifeguard in-service training day to address any questions about the study. At the same time, I applied to the University of Auckland for a summer research student scholarship to conduct the data collection, and this application was successful. This resulted in a third-year medical student being assigned to me for ten weeks. We also had a fifth-year medical student from The University of Otago choose to do their elective with us, and this person also assisted with the fieldwork. I provided training to both students, which included study protocols, assessment techniques, and how to use the CPR manikin and data-collection

software. As the supervisor of both medical students, I was required to provide a report at the end of the project to their respective universities.

This research required specialised modifications to the electronic data-collection software to accommodate for the differences in the child CPR manikin used for the study (Webber, Moran and Cumin, 2019). I liaised with the manufacturer to confirm that the data-collection system would gather all the elements required. When our target of 250 candidates was reached, I checked and transcribed the raw data into an Excel spreadsheet for subsequent analysis by Dr Moran and Dr Cumin. As a team, we agreed on what parts of the manuscript each person would be responsible for. I provided the framework for the manuscript and wrote the background, methodology, discussion, and conclusion. Dr Moran and Dr Cumin wrote the results section and provided input into all other parts of the manuscript.

When the manuscript was complete, I edited it to comply with the journal's formatting requirements and submitted it via the publisher's online portal. After the paper was peer-reviewed, I collated the team's responses to the reviewer, made the necessary changes, and resubmitted the manuscript. Once accepted for publication, I then promoted the article to stakeholders, interested parties, and the study participants who were interested to see the results and check the answers they had given to the knowledge-test questions. One method used to achieve this was to send a project update to all lifeguards in the SLSNR weekly e-notices (Webber, 2017). This was important, as the study involved a knowledge quiz, and the project team had been contacted by study participants wanting to check if their answers were correct.

The NZRC has also assisted in publicising research outputs in their e-newsletter *Adrenaline Rush*, which is sent to first aid and resuscitation instructors nationwide. An example of this was when the article '*Dry drowning' and other myths* was published (New Zealand Resuscitation Council, 2018). What impact or reach these strategies have had is not something I have been able to measure, however.

Sentinel: an in-depth look at creating a model

For Sentinel, my role involved conceptualising and co-developing all aspects of the system with co-author Billy Doyle. The idea for Sentinel was vested in our combined SLS experience of 40 years, having both worked as paid lifeguards, been patrol captains, and held the office of Director of Lifesaving for our respective regions. Billy and I had almost identical career

pathways. We both: completed nursing as our undergraduate qualification; were volunteer ambulance officers for St John; taught first aid and emergency care to lifeguards; (and) in later years became advanced cardiac life support instructors. We also developed a mutual interest in human factors and crisis management. Billy was introduced to these concepts much earlier than I was, however, having been an officer in the New Zealand Army. Thus, from the outset, we had a shared understanding of the foundations of Sentinel (such as principles of triage) and could speak the same language. This proved invaluable in terms of how quickly we were able to formulate an initial draft of the model.

We were also fortunate that the existing systems that we wanted to combine into Sentinel were not too dissimilar. Szpilman's Drowning Classification System was comprised of six grades, the patient status codes used by the ambulance service in New Zealand had four (plus one for deceased), and the Australasian Triage Scale, five (Szpilman, 1997; St John, 2016; New Zealand Ministry of Health, 2018). Words such as 'critical', 'serious', 'moderate', and 'low' as used in these systems to describe a patient's clinical condition were a good match for the levels of submersion-risk that we wanted to categorise. So, from the beginning, there was an existing level of consensus inherent in Sentinel even before we started to work on the finer details of the model.

Around the time when the idea for Sentinel first came up, SLSNZ had just released a proposal to introduce 'Patrol Support' members; these were volunteers unable to fulfil the water-based aspects of lifeguarding but trained to perform other tasks like first aid, water surveillance, and operating the radio. In response to this, Billy conducted a pilot study that compared the detection time of drowning victims between swimmers and non-swimmers; it found that non-swimmers took longer (Doyle, 2007). This correlated well with our primary goal for Sentinel, which was to improve distress/drowning detection times. It also provided some real-world relevance and evidence for the project we were embarking on.

Our key motivator for developing Sentinel though was observations we had made on lifeguard duty, and autoethnographic accounts where some responses seemed too urgent, yet others were not urgent enough. There appeared to be an inverse relationship between the number of victims and the 'quality' or coordination of the response; the more people in distress, the less effective the response. Victims with a low threat to life were often rescued before those with a high threat to life, and seldom was a lifeguard or rescue tube deployed from the inflatable rescue boat, or a rescue board used to provide buoyancy support.

I have no recollection of any serious disagreements as the model evolved from initial concept into its final stages of development. Any differences of opinion were resolved by discussion until a consensus was reached. We also thoroughly reviewed the frameworks on which the model was based to ensure our understanding of them was complete and up to date, and sought input from external experts into the proposed design, e.g., SLSNR's Medical Director, Dr Peter Jones (Jones, 2007).

Since designing the system, I have been responsible for updating it in response to user feedback, changes in practice and any relevant external factors like the introduction of the ambulance service's new system of colour-coded response levels, which resulted in us changing the colour used for 'status one' from black to purple. An example of the feedback we received is provided in Section 5.3, and the original model, as it was first presented in 2007 can be viewed here. The differences between this and Appendix E reflect the evolution of the model over the past decade.

In summary, although the type and variety of PWDPs in this context statement cover a range of outputs and audiences, the common theme that unites them is the recommended actions in the Drowning Chain of Survival (Table 5). Having this foundation is vital as the ability to reference the intervention to this model not only provides a baseline for measuring its effectiveness but also ensures the model itself is subject to regular critique and review, and is still relevant to those who use it.

5.3 Transdisciplinary approach, multidisciplinary teams, and communication strategies used in creating the works

Translation process

A discussion on the translation process starts with a definition of what is meant by this term. In defining the translation process, what is being referred to is translation studies:

> "A field of study that deals with the theory, description, and application of translation. Because it examines translation not only as interlingual transfer but also as intercultural communication, it can also be described as an interdiscipline which touches on other diverse fields of knowledge [that includes] comparative literature, cultural studies, gender studies, computer science, history, linguistics, philosophy, rhetoric, and semiotics. Translation studies is often paired with interpreting, although the two are distinct fields" (University of Exeter, 2019).

My role has not therefore been to translate the public works from one language to another (although some have taken place in, and are used by non-English speaking countries), but like my fellow co-authors or team members, to act as a: transdisciplinary translator; facilitator of professional connections and communication; (and) negotiator between the differing realms of experience, knowledge and disciplines that exist within a professional workgroup (Maguire, 2012). In Chapter 7, translating evidence into practice, and my role is presented as a separate but highly relevant and connected discussion.

One of the ways I have been able to achieve this, especially with patient care and water-rescue guidelines has been through the application of my work-based experience, and from providing support to lifesaving agencies in LMICs, such as Pakistan. To ensure the PWDPs have utility, i.e., end-users can apply them at various qualification-levels in high or LMICs, a key area I have been involved in is the translation of scientific, medical, and technical data into plain English guidelines/pictograms. An example of this was *Drowning terminology: not what it used to be*, a letter published in *The New Zealand Medical Journal* (Jones, Moran and Webber, 2013). In addition to describing the new terminology, the article explained why the old terminology was redundant, and why all health professionals should become familiar with, and start using the new terminology.

Other PWDPs like the Sentinel System for Response to Drowning and *Guideline 9.3.2 – Resuscitation of the drowning victim* have been influenced by my hands-on experience in rescuing and resuscitating drowning victims for over 30 years at one of New Zealand's busiest beaches. In a group environment, where some team members work in a hospital or academic setting or come from a purely medical background, one of the biggest challenges has been to assist these people in producing a PWDP that is fit for purpose.

In New Zealand, volunteer surf lifeguards can qualify at 14 years of age. A complicated resuscitation guideline written by a medical professional but intended for use by paramedics or paid lifeguards working full-time may be inappropriate for a young, seasonal volunteer. A scenario like this would have to be resolved by either developing two distinct guidelines or facilitating a discussion to agree on one guideline that could be used by either group. Situations like this have seen me act as a knowledge translator to find a compromise that achieves the desired outcome.

The dilemma facing the writing team in situations like these becomes apparent when there are competing interests of simplicity and ease of application versus ensuring patients

receive a consistent and high level of patient care. As a member of the ILS Medical Committee, discussions such as these, and even disagreements are not uncommon when guidelines are being written for an international audience. The reality, however, is that a uniform standard of care represents utopia given lifeguard, rescue, and ambulance services are not universally resourced to the same level or may not even exist in some parts of the world.

The final consideration relates to what most people would understand translation to mean, which is interpreting the works from English into the native language of the region or country where the PWDP is going to be used. One of the many challenges that occur during this process is that at times, there is no equivalent word or phrase in the foreign language. An example of this is the term 'near-drowning' that although no longer used, could not easily be translated in some languages.

Other nuances, such as intent and tone also present difficulties and rely heavily on the writing team to ensure written English is both clear and unambiguous. It has been important that the native language-speaker who will be translating the work has a good understanding of these subtleties and seeks clarification to confirm their understanding. This is vital, as the message recipient is also the message transmitter. That said, an essential aspect of teamwork is trust, and the expertise of the native-language speaker to accurately interpret the work must be respected.

One of the most mentally challenging aspects for me has been reviewing PWDPs written by team members who speak English as a second language. Trying to decipher the intended meaning or tone of the text has involved developing new skills in making an educated guess and then checking with the writer to confirm I have adequately expressed what they wanted to convey. While at times I have found this process exhausting, I have developed an immense amount of respect for my co-authors, however, who must find the process infinitely more difficult given they are not writing in their native tongue.

Figure 5.3: The Drowning Chain of Survival translated from English to Portuguese.

The sector should, therefore, encourage practitioners fluent in multiple languages to assist in this important role. An example of an entire paper where I reviewed and corrected all the English was, *Is drowning a mere matter of resuscitation?* (Szpilman et al., 2018), and the Portuguese translation of the Drowning Chain of Survival is shown above in Figure 5.3.

Multidisciplinary approach

The benefits of working in an MDT have been documented across numerous industries (Iliffe, 2008). The purpose of an MDT is to gain a variety of insights and approaches to solving a problem or undertaking a task from team members representative of different professional, ethnic, and social groups who share a common goal. In healthcare, it is proposed that this results in better outcomes for patients, enhanced satisfaction for health professionals, and more efficient use of resources (NSW Government, 2019).

Tomek (2011) refers to two types of team that can exist; ad hoc teams that assemble to accomplish a specific task and then disband, and true teams that operate for a longer or indefinite period. He asserts that "globalization has led to new forms of teams that are diverse in age, education, culture, ethnicity, language, and often geographic location" (Ibid., p.191), and these issues will be discussed later in this section. During my career, I have and continue to be a member of such teams. These teams may be interdisciplinary, meaning from within the same discipline, e.g., lifeguarding or more commonly multidisciplinary, where the team is made up of a larger professional group. For me, ad hoc team membership usually arises from an invitation to take part in a research project or being asked to contribute to a writing team. In contrast, true team membership comes, for example, from my involvement in regional, national, and international committees like being a co-opted member of the NZRC Executive.

What is unusual, but not unique in respect of my colleagues is that I have worked transdisciplinary across several fields, namely, drowning prevention, lifeguarding, ambulance, hospital, and tertiary education. Having run my own business, I have also brought finance, marketing, and sales skills to the team, and this can have relevance to the production and promotion of public works, e.g., promotion, budgeting, and fund-raising. This background has allowed me to input to the production of the PWDPs at many levels while still maintaining my primary focus, which is drawing on the work-based experience and learning I have amassed from rescuing and resuscitating drowning victims in the field.

As a team leader, the usual reason for engaging a person from another discipline to

join the group has been for the expertise they bring to the project. It can include other reasons, however, such as wanting indigenous community or patient input. An example of this was *Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards*. For this project, technical analysis of Excel datasheets was required, and Dr David Cumin was asked to join the team for his expertise in this area. It has also been recognised that "it is a far different challenge to lead teams whose members are physically co-located than it is to lead a team comprised of people spread out all over the world…who seldom, if ever see each other" (Ford, Piccolo and Ford, 2017, pp.25-26). I would contend that being a member of a remote team is equally as challenging as leading one.

One of the main benefits that I have found from working in an MDT has been the ability to integrate scientific research into practice, and developing the compromise and negotiation skills required when this contradicts experienced providers or the policies and procedures of stakeholder-organisations that may have been in place for years. An excellent example of this was *Guideline 9.3.2 – Resuscitation of the drowning victim*. This revised guideline required all drowning victims to be assessed on their back. For Australian lifeguards, this represented a significant change of practice; previously, all patients had been assessed on their side. There was no evidence, however, to show assessing a patient in one position compared to another affected outcomes. We were able to argue, however, that rolling the patient on their side to assess them, and then onto their back to perform CPR, would delay treatment. This delay could have an adverse effect on patient outcomes.

Working in an MDT is not without its challenges though. Iliffe (2008, p.101) states "teamwork can be stressful; [it] can expose role ambiguity and opposing values and provoke interpersonal conflict". Furthermore:

> "Employment status differences, cultural differences between professions, geographical separation and membership of multiple teams were barriers to team working. (Gregson, cited in Ibid., 2008, p.101; Audit Commission, cited in Ibid., 2008, p.101). Physical proximity, social proximity and positive motivation are prerequisites to collaboration and team working (Poulton and West, cited in Ibid., 2008, p.101). The size of the team's membership also appears to be an important factor, with three to six offered as the most effective group size for decision making and communicating" (Ovretveit, cited in Ibid., 2008, p.101).

Other problems that I have encountered include time-zone differences, cross-generational

issues, uneven distribution of the workload, tasks not being completed on time, language barriers, philosophical differences, and competing personal interests. Many of the MDTs I have been involved in to produce PWDPs have involved an international group, whereas others were produced locally.

Although many features of working in an MDT are common to both local and trans-national groups, not surprisingly, it has been my experience that the challenges are more apparent with global or virtual teams. How these issues are resolved is, for the most part, down to compromise, mutual respect, and communication strategies. An acceptance also of the democratic process and the fact not all decisions will go your way is, in the author's opinion, a necessity when working in an MDT.

Communication strategies

In this section, I review the communication strategies I have employed during the creation of the PWDPs, engagement with stakeholder organisations, and how, once created, the PWDPs are publicised and made available to the sector. The process for receiving and responding to feedback is also discussed.

Previous studies have identified that "high-performing teams coordinate effectively by sharing information before it is needed, rather than explicitly requesting teammates to perform actions or exchange information" (Butchibabu et al., 2016, p.595). This type of communication is known as implicit coordination. Most of the team members I work with I have encountered on other projects, or in some cases, e.g., IDRA there is a true team, so the membership does not change. In this setting, a high degree of implicit coordination exists. Even in high-performing teams, though, some of the most critical communication needs to occur during the planning phase.

In a motivated team, there is often much enthusiasm to get started with the fieldwork, however, in terms of the overall project timeline, it is recommended that up to two-thirds is allocated to the preparation phase (Bierens, 2014). Typically, this involves an initial planning meeting to scope the project. This, like all project meetings, should foster open dialogue and the ability to brainstorm ideas (which aids decision-making), allocation of responsibilities, and agreeing on milestones. Inadequate preparation can lead to problems at a later stage that may affect the team's ability to complete the project on time (or at all). The communication strategy I have employed at this stage is based on the premise that all ideas are worthy, and

it is crucial that each team member can contribute and be heard. Then, by discussion and negotiation, some suggestions are discounted or revised, but this open and respectful environment sets the tone and expectation for how team members communicate for the remainder of the project.

When it comes to communicating my point of view, I have always valued the skills I bring to a group as both a field-practitioner and researcher. These include being a clear oral communicator and having excellent written communication skills. I am also a good listener and recognise the importance of everyone in the team having an opportunity to contribute. I have no issue standing up for what I believe in while at the same time, being open and flexible to other ideas. This was especially true in *Guideline 9.3.2 – Resuscitation of the drowning victim* when the issue of whether patients should be assessed on their back or their side was being debated, and there was resistance from some of the Australian representatives to changing to what was done in New Zealand. It should also be noted that "diversity brings creativity and innovation" (University of Waterloo, 2019), and most of the PWDPs I have been involved in producing exist to address a public health issue. It would be negligent, therefore, to stifle new ideas and creative thinking when it could provide a better solution than existing strategies.

Often, team members that I have worked with do not speak English as their first language. This makes communication strategies like perception-checking, to ensure accurate understanding, fundamental. It also confirms that team members are fully engaged, have all the information they require, and feel that their input is valued. One of the risks of working with the same team of authors (or even different authors), is the assumption of similar interpretations. There have been instances where I assumed a team member would agree with my point of view; however, this was not the case. I have made a conscious effort, therefore, to own all opinions by prefacing them with 'I think' or 'my view is' for example. In my experience, these strategies make decision-making by consensus easier and improve team performance. Ultimately, they ensure the PWDPs have greater applicability to more countries and aquatic settings.

In presenting PWDPs or speaking in a group setting, I am frequently reminded of the fact that speakers of New Zealand English talk fast, and the accent can be hard to understand. This can present a barrier to effective verbal communication. The strategy I have employed to address this is making a conscious effort to speak slowly and asking the group or audience

to indicate if they are having trouble understanding me. As a matter of courtesy and business etiquette, I always make a point of thanking team members after any meeting or completion of a PWDP for their input. This is important in any setting, but even more so when I will be working with the same group of people on future projects, and most team members are volunteering their time.

All the PWDPs submitted in this context statement have required engagement with stakeholders at some level, whether they are directly involved in the project, as is the case when I have conducted research on-site with lifeguards, or end-users, such as public safety agencies or educators when the works are complete. For research projects, the process typically starts with a formal letter to request permission to engage with the stakeholder and their members. This is followed by a meeting with management to explain the intent of the project and address any initial concerns the organisation may have. Once permission is granted, the next step is to agree on the study design and apply for ethics approval.

Applications for ethics approval that involve human participants are typically evaluated against the *Nuremberg Code*, which states:

- "Voluntary participation is essential
- Researchers must fully inform participants
- Risks are minimised
- Researchers must protect participants against even remote harm
- Participants are free to withdraw from the study at any time
- Research is conducted by qualified people
- The study must stop if things are going badly (causing harm)
- Society should benefit from the study of the findings (not frivolous)
- Research on humans should be based on previous animal or other previous work (where applicable), [and]
- A research study should never begin if there is a reason to believe that death or injury may result" (Visser, 2019).

Four principles that are cited as fundamental to ethically conducted research are autonomy, beneficence, non-maleficence, and justice: each underpinned by respect for people in all aspects (Ibid.). Conducting research on a global scale is associated with many challenges, some of which include ensuring that ethical standards are maintained equally in LMICs, the research responds to a health condition present in that community/region, and there is a fair distribution of the research benefits and burdens amongst the groups of the study population (Council for International Organizations of Medical Sciences, 2016).

Written communication, including project plans, study protocols, ethics approval, consent forms, updates, and the results of the study should always be provided. Like all forms of communication, written material can be misinterpreted or not received. Confirming receipt and understanding of these documents is therefore vital. The strategies I have used to achieve this include follow-up phone calls or emails, and in some cases, having the recipient sign and return a form to this effect. Ensuring that a member of the project team or I am available through a variety of means, e.g., telephone or email is also essential so that stakeholders can receive a timely response to enquiries. Organisations that I have engaged with, like SLSNR, are more likely to cooperate on future projects if they are communicated with professionally.

Once a PWDP has been produced, the next consideration in terms of communication is how it will be transmitted to the end-user be they an organisation, lifeguard, or member of the public. Some of the strategies I have employed to achieve this have been promotion of the PWDP through social media, press releases, requesting other organisations, e.g., NZRC and ILS to assist with publicity, presenting at conferences, and the use of personal contacts. Publications in journals are often only available with subscriber-access, so providing read-only copies or making manuscripts available in their unpublished form (without infringing on copyright) are two methods I have used to prevent access being restricted. Fortunately, many PWDPs are by their nature 'public', which for the most part, makes them open-access.

Given the highest numbers of drowning are in LMICs, ensuring cost is not a barrier to the use and implementation of these works is imperative. There is still a need for more traditional communication strategies, however, e.g., books, oral presentations, and print media for use in those parts of the world that do not use social media or have limited access to the internet and smartphones.

The final aspect of communication that occurs once a PWDP has been produced is to request and respond to feedback. This only occurs for some PWDPs, and the feedback may be informal, for example, a conversation with another person during a conference lunch-break, or, as was the case for the Drowning Chain of Survival, in a formal feedback session. In some instances, feedback may not be requested, but it is still received. For articles submitted to scientific journals, the manuscript is peer-reviewed, and responses or revisions are usually required. The ability to dispute a recommendation exists; however, my strategy has always been to accommodate these requests as the same person will typically review the revised manuscript, and they have been selected by the editor for their expertise.

Once published, feedback typically comes in the form of a letter to the editor, and the editor usually invites the author(s) to reply. I have been involved in both sending letters to the editor and replying to letters from other authors or readers (Webber et al., 2017; Baker and Webber, 2014). As is the case with Sentinel, since its creation in 2007, the model has been updated multiple times to reflect changes in practice and in response to feedback from end-users. Without this feedback, it would not have evolved and may have become outdated or irrelevant. An example of the type of feedback received when Sentinel was first presented to SLSNR lifeguards back in 2008 follows to illustrate that there are areas for improvement we are yet to address. These are essential considerations in any future study that attempts to validate the model:

> "More work needs to be done to make [Sentinel] entirely relevant in a practical, surf lifeguarding environment. Smoother integration with existing practices, incorporation of pre-water identification of potential victims, distinction between stages of drowning and physiological status, inclusion of environmental factors and potential rescue capabilities, recognition of the potential for rapid changes in a victim's 'threat to life' are all key areas for enhancement" (Hammond, 2008).

One of the challenges when receiving and responding to feedback, however, is to do so without emotion or taking the feedback as a personal criticism of your work. This is difficult when months or even years have been invested in producing the PWDP. Understandably, there is a strong sense of pride and ownership as an author. However, I have always employed a strategy of firstly thanking the person or organisation for their feedback, trying to address any concerns or points they raise gratefully, and holding the basic assumption that they are considerate, well-educated people, equally committed to reducing drowning and improving outcomes for patients like I am. In my view, this results in a more constructive, less emotive response to feedback received.

5.4 Regional, national, and international impact

The subtitle of this context statement is 'The influence of New Zealand lifeguarding practice on global drowning prevention'. In this section, I outline the impact of the PWDPs that have either been produced in New Zealand or as part of an international consortium but influenced by New Zealand lifeguarding practice. While it is not possible to provide an impact assessment

for all the PWDPs produced, a selection of how they have been cited, adopted into policies and guidelines, publicised, and used by other organisations both locally and internationally is provided. How many lives have been saved is difficult to quantify, however, in terms of my motivation as a researcher, surf lifeguard, health professional and humanitarian, to reflect on the impact of these works is very rewarding, nonetheless. At the same time, it is also very humbling as the works have not been produced in isolation; they are the combined efforts of my co-authors and the organisations to which we all belong.

Over 40 articles, book chapters, and conference abstracts have been cited over 300 times, with an h-index of nine (Google Scholar, 2020). The most cited articles are *Creating a drowning chain of survival* and *Failure to ventilate with supraglottic airways in drowning*. The Drowning Chain of Survival was included in the *European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances* (Truhlář et al., 2015) and achieved recognition in the *Resuscitation highlights in 2014* editorial (Nolan et al., 2015). The model was also adopted by the NZRC in their advanced life support textbook *Resuscitation – A guide for advanced rescuers* (New Zealand Resuscitation Council, 2016).

Figure 5.4: Public education using the Drowning Chain of Survival in Brazil. Photo credit: David Szpilman.

The Drowning Chain of Survival (Figure 1.1) was also published as an MPS by ILS (International Life Saving Federation, 2016), and most notably in Brazil (Figure 5.4), it has been used extensively in public education (Sociedade Brasileira de Salvamento Aquático, 2019). The media also covered the global release of the Drowning Chain of Survival, and water safety

agencies promoted it (Scoop, 2014; Surfrescuenz, 2017; Surf Life Saving New Zealand, 2014).

In 2018, a study out of Brazil was published that for the first time, applied the five links of the Drowning Chain of Survival (summarised into three main categories of prevention, rescue, and first aid) to an operational lifeguard service over six summer seasons (Szpilman et al., 2018). From a total of 1,565,699 lifeguarding actions, there was an "estimative incident rate for each day at a lifeguarded beach…of one rescue for every 4,227 beach attendances, one drowning for every 24,338 beach attendances, and one instance of CPR being performed for every 617,142 beach attendances" (Ibid., p.103). These findings validate the fact that prevention is not only the most prevalent (99.8%) but also the most important intervention undertaken by lifeguards (Ibid.).

The study also featured in the *Resuscitation highlights in 2018* editorial (Nolan et al., 2019). With the need for performing resuscitation less common, this has training implications for lifeguard services as infrequent events require education on a more frequent basis to prevent skill decline. This is well documented among health professionals that also perform CPR infrequently (Niles et al., 2017). Several limitations were noted by the authors, however, and these included: they were not able to measure the financial costs of performing the interventions; for ethical reasons, it was not possible to randomise victims into control and intervention arms; (and) that the study was conducted using a well-organised, paid lifeguard service with high levels of public education. The results, therefore, may not be transferrable to other locations, lifeguard services, or populations (Szpilman et al., 2018).

Failure to ventilate with supraglottic airways in drowning documented the first use of an i-gel® supraglottic airway device in drowning. Although this was only a single case report, given the lack of evidence and claims by manufacturers that these devices were suitable for use in drowning (LMA North America Incorporated, n.d.), this paper has been referenced in journals, medical textbooks, and ambulance service clinical practice guidelines (Henlin et al., 2014; Schmidt et al., 2016; Main and Hooper, 2017; St John, 2016). The study has resulted in a retrospective case series of i-gel® use also being reported (Dykes and Morgan, 2015) and calls for more research into the effectiveness of this class of device in drowning resuscitation.

Continuing the theme of resuscitation and first aid, six papers that involved studies on New Zealand surf lifeguards were received by individual members, surf clubs, SLSNR, SLSNZ, the media, and overseas lifeguard services. A recent decision by SLSNZ to implement CPR feedback training manikins is discussed in Section 7.3, and the results of these studies were

also presented at several conferences (Moran, 2013; Webber et al., 2017). Some studies, e.g., *Surfing injuries requiring first aid in New Zealand, 2007-2012* have also provided information that has been used by researchers in other disciplines; in this case, injury prevention in surfing (Furness et al., 2015). According to SLSNZ's medical director, the studies have:

> "Helped guide SLSNZ training initiatives in CPR, paediatric CPR, and first aid, as well as helped inform my own discussions/initiatives as the SLSNZ medical director. [The] studies have been discussed within SLSNZ, at the [NZRC], and at [ILS]. Given that there are not many publications that focus specifically on New Zealand surf lifesaving, the studies…have been all the more important, relevant, practical and useful" (Payinda, 2019).

A full impact assessment on the value of the studies to SLSNZ can be found in Appendix F.

The 4Rs of Aquatic Rescue (Figure 4.2) is used by DPA in their community education programmes and online learning portal (Drowning Prevention Auckland, 2015). I presented the 4Rs during a live breakfast television interview following a bystander rescuer fatality in 2015 (Surfrescuenz, 2019). The media have been encouraged, with limited success, to remind readers of what to do whenever a person drowns while attempting a rescue (Leask, 2017); the expectation is that this information will be published for all such incidents. A 2017 study showed that "knowledge of safe bystander rescue techniques and protocols improved as a consequence of participation in the water safety programme" (Moran, Webber and Stanley, 2016, p.7). This programme involved teaching participants the 4Rs of Aquatic Rescue.

The *2015 Revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation*, published in 2017, were an update to the 2003 ILCOR advisory statement of the same name. Having provided drowning researchers with a core dataset that should be collected from a drowning incident, a recent study identified only 14 publications between 2003-2015 that utilised the recommended criteria (Venema et al., 2018). The purpose of the updated guidelines still reflects what was stated in 2003:

> "To establish consistency in the reporting of drowning-related studies, both in terms of nomenclature and guidelines for reporting data…[and] improve the clarity of scientific communication and the comparability of scientific investigations. Improved clarity and comparability of future…reports will advance the clinical and epidemiological knowledge base. In turn, such studies can help identify appropriate prevention strategies as well as the best treatment for victims of drowning" (Idris et al., 2003, p.45).

Significantly, the WHO has just published a working definition of non-fatal drowning and a framework for classifying the severity of these incidents (World Health Organization, 2019).

Guideline 9.3.2 – Resuscitation of the drowning victim resulted in a change of practice for lifeguards in Australia. This change involved assessing the victim on their back, as opposed to their side, which had been the established practice for many years. The benefit of using the same guidelines reflects many similarities between New Zealand and Australia in terms of how lifeguard services operate and the training that staff receive. This makes qualifications more transportable.

The guideline is intended to improve the quality of patient care by ensuring first responders provide a consistent approach and prioritise their interventions based on those that have been shown to improve the victim's chance of survival. This guideline has also been adopted by all first aid training providers in Australia and New Zealand. As no studies have reported patient outcomes under the old guideline compared to the new one, this measure of impact cannot be reported on.

Figure 5.5: PALS lifeguards providing disaster relief in a coastal fishing village following a storm in Karachi, Pakistan. Photo credit: Reza Samad.

Before PALS commenced lifeguard patrols in 2004, over 250 people drowned every year along the coastline of Karachi. The current drowning toll now averages under five per annum, with most occurring when lifeguards are off duty (Pakistan Aquatic Life Saving, 2016). The aid provided to assist PALS in becoming an entirely self-sufficient organisation has been hailed as one of the best examples ever of how to establish lifeguard services in a LMIC. In

addition to keeping beachgoers safe, PALS has also assisted with disaster relief and aid distribution during civil emergencies and provided paid employment to over 150 lifeguards (Figure 5.5). This, in turn, helps to reduce poverty by providing a source of income to families in coastal villages. Since its inception in 2004, PALS lifeguards have performed 5,000 rescues, 6,028 first aids, 7,266,181 preventive actions, and 517 searches for missing children (PALS Rescue, 2019). PALS is now a full member of ILS and the Royal Life Saving Society.

Despite still being a relatively new organisation, IDRA has been able to establish itself as an international, independent network of drowning prevention researchers (International Drowning Researchers' Alliance, 2019). Like many NGOs, IDRA's ability to achieve some of its goals is restricted by the fact that those doing the work are volunteers, and the organisation currently has no funding. That has not, however, prevented the founding members from undertaking essential tasks such as incorporating the organisation, registering it as a charity, and developing a strategic plan and terms of reference. There have been several publications in the name of IDRA (Szpilman et al., 2016; 2018), newsletters produced, workshops for emerging researchers, and a Young Researcher Award. IDRA has also undertaken preliminary work on developing a virtual discussion group and file-sharing platform for members.

Not all public works I have been involved in have had the desired impact or reach though. Sentinel was developed primarily for use by lifeguards in New Zealand, but the uptake of the model has been limited. The system has been used in Portugal, Spain, and the USA, however. Sentinel provides an excellent example of how the perceived success of a PWDP can differ from an author's perspective (when directly involved in the production of the work), compared to how others view it, or how the impact on the sector or end-users is measured.

Five themes are now evident, however, that link the PWDPs submitted in this context statement and the impact they have had:

1. The relevance of the author's career experience to the production of the works
2. The influence of New Zealand lifeguarding practice on global drowning prevention
3. The ability to translate work-based research into sector knowledge
4. The emergence of future applications for the works (and research opportunities), and
5. The Drowning Chain of Survival as a baseline theoretical framework.

Chapter 6. The New Zealand drowning scene

Having considered the international context and relationship of the PWDPs to activities in this sphere, in this chapter, the drowning problem from a New Zealand perspective is discussed. The chapter provides an overview of the:

- Geographical aspects of water hazards in the country
- Agencies working to reduce drowning
- The New Zealand Water Safety Sector Strategy 2020, and
- Drowning amongst Māori and new settler populations.

Geographical aspects of water hazards

New Zealand has approximately 15,000 km of coastline, with "the exact length…obscured by the countless twists and turns around inlets, headlands, spits, bays, harbours, fiords, sounds and estuaries. There is no location in New Zealand that is more than 130 km from the sea" (Walrond, 2005). In addition to the coastline, inland water hazards are abundant. These include lakes, rivers, glaciers, gorges, and ponds. The country is geothermally active with geysers, boiling mud pools, and hot springs in some areas. At Hot Water Beach (Figure 6.1), tourists dig holes in the beach that fill naturally with hot water in which they can bathe.

Figure 6.1: Steam rising from a hole dug at Hot Water Beach on the east coast of the North Island of New Zealand. Photo credit: Destination Coromandel.

"All of New Zealand is at risk of earthquakes, and all of [the] coastline is at risk of [a] tsunami" according to the Ministry of Civil Defence and Emergency Management (MCDEM)

[2019]. This threat depends on where the precipitating earthquake occurs:

> "A distant source tsunami, like one generated from Chile, could take 14 hours or more to arrive. A regional source tsunami, like one generated from the Southwest Pacific, could take between one and three hours to arrive. In these cases [there will be] time to issue official warning messages. A local source tsunami generated from an earthquake close to New Zealand can arrive at…coastal areas within minutes" (Ministry of Civil Defence and Emergency Management, 2019a).

It is floods, however, that MCDEM state "is New Zealand's number one hazard in terms of frequency, losses and declared civil defence emergencies. Floods can cause injury and loss of life, damage to property and infrastructure, loss of stock, and contamination of water and land" (Ministry of Civil Defence and Emergency Management, 2019b). As discussed in Chapter 1, the increased frequency of natural disasters presents new and additional challenges for emergency services and water-rescue agencies like SLS.

Agencies working to prevent drowning

WSNZ is the peak body responsible for coordinating drowning prevention in New Zealand. It is a membership-based charitable organisation comprised of 37 entities that "cover a wide range of water activities and initiatives that have water safety and drowning prevention [as] fundamental to their missions" (Water Safety New Zealand, 2019a). A full list of the members of WSNZ can be found in Appendix G. Four organisations, SLSNZ, Coastguard New Zealand, Swimming New Zealand, and Plunket have been deemed National Infrastructure Agencies and Programmes in recognition of the core services that they provide.

WSNZ provides a limited amount of contestable investment funding into the sector that members and non-members can apply for annually. To access this contestable funding, projects must align with the *New Zealand Water Safety Sector Strategy 2020* (NZWSSS). In 2019, the total amount available was $2m; a fraction of what the government spends on other forms of injury prevention (Water Safety New Zealand, 2019b). A detailed list of the 2019 recipients and projects funded can be found here.

SLSNZ is the charity representing the 74 SLS clubs that patrol New Zealand beaches (Surf Life Saving New Zealand, 2019). SLSNR has a similar role to SLSNZ but represents the 17 clubs in the northern region of New Zealand (Surf Life Saving Northern Region, 2019). Both organisations exist to support the activities of their member clubs and in addition to lifesaving

infrastructure, deliver sport and community education programmes. My involvement with these and other locally-based organisations was outlined in Chapter 2.

Coastguard is the charity providing maritime search and rescue services from 63 bases nationwide (Figure 6.2). Of these, 59 are rescue vessels, two are fixed-wing air patrol units, and two are communication centres (Coastguard New Zealand, 2019).

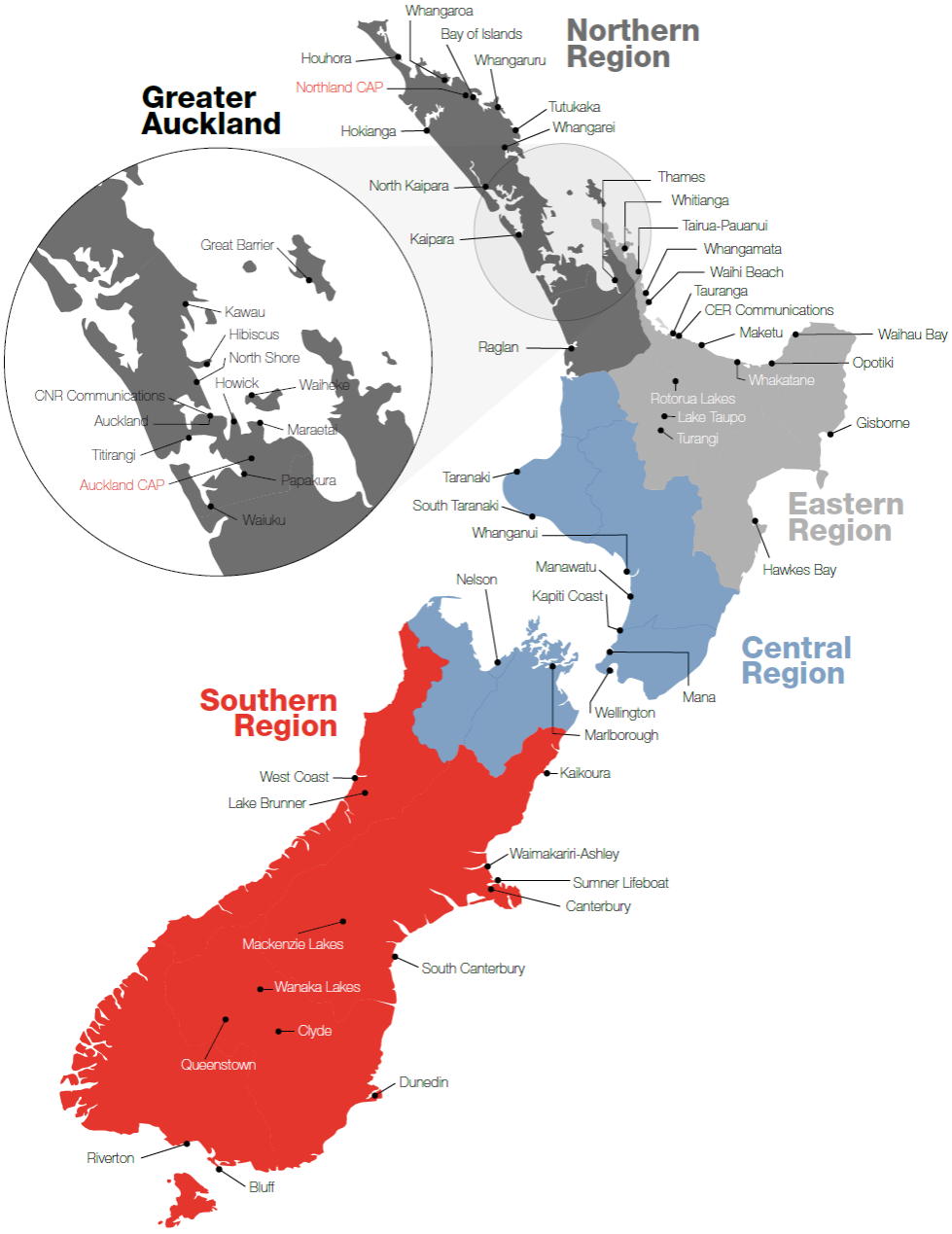

Figure 6.2: Location of coastguard units in New Zealand.
Image credit: Royal New Zealand Coastguard.

Coastguard and SLSNZ work with the New Zealand Police, who are the legislated lead agency for marine incidents within 12 nautical miles of the coastline (New Zealand Police, 2019).

Swimming New Zealand is the peak body primarily concerned with high-performance competitive swimming. In the water safety space, however, it coordinates the delivery of WSNZ's Water Skills for Life. "Developed for children in Years 1 – 8…[and] based on 27 core skills, [the programme aims to establish] broad fundamental competencies for life-long water safety" (Water Safety New Zealand, 2019c).

Plunket is an organisation that sees more than 90% of newborn babies in New Zealand. They also offer support to new parents and conduct development assessments of children (Plunket, 2019a). Plunket is WSNZ's delivery agent of water safety education to parents in the pre-school space (Plunket, 2019b).

Although a regional body, DPA services an area where more than one-third of the population (1.66 million) lives (Auckland Council, 2019). Auckland has the most diverse ethnic community of any city in New Zealand and the largest Polynesian population in the world. DPA's aim is "to effect behaviour change, helping people to operate differently around water, developing risk-awareness, water consciousness, and water competence to keep themselves and others safer in, on, and around water" (Drowning Prevention Auckland, 2019a). DPA is the lead water safety research-producing organisation in New Zealand (Drowning Prevention Auckland, 2019b).

Many other organisations throughout New Zealand deliver water safety programmes and swim and survival education. That they are not all listed here does not detract from the fact their efforts are worthy and they make a valuable contribution to drowning prevention.

New Zealand Water Safety Sector Strategy 2020

The NZWSSS was published by Water Safety New Zealand (2015) and outlines the vision and mission for the sector. There are three key outcomes and 12 goals to achieve by 2020. The NZWSSS centres on a collaborative effort to address New Zealand's drowning problem, underpinned by research, and identifies males and pre-schoolers explicitly as high-risk groups. There are targets to reduce drowning deaths to 50 and hospitalisations to 100 or less per annum, halve male drownings, and to eliminate pre-school drownings (Ibid.). The strategy is also used to guide WSNZ's financial investment into the sector. Figure 6.3 shows the sector progress towards reducing preventable drownings and hospitalisations.

Evidence that the collective impact of the sector is having a positive effect can be seen in New Zealand's *2018 Provisional Drowning Prevention Report* where the second-lowest

preventable drowning toll was recorded (Water Safety New Zealand, 2019d). As discussed in Section 1.3, the reasons for a continued increase in hospitalisations, despite a drop in 2018, requires further investigation.

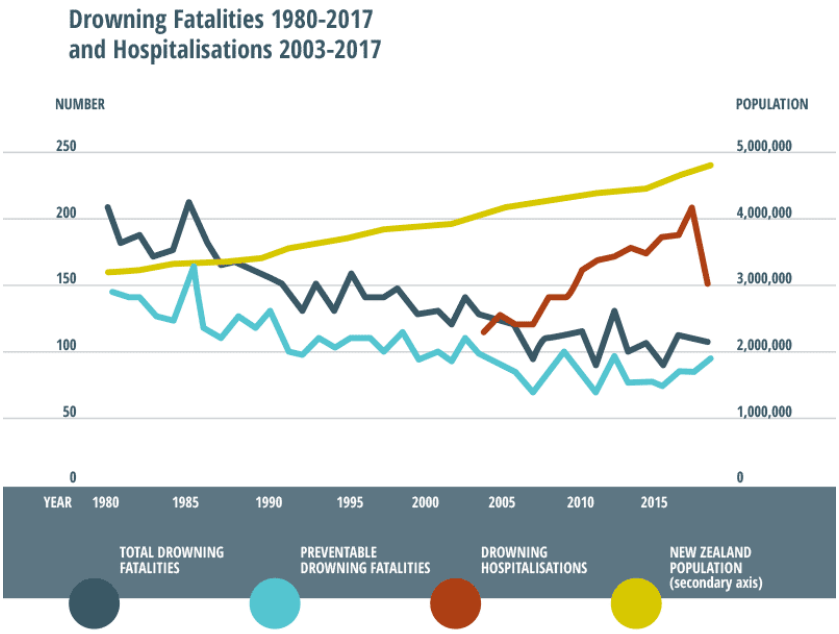

Figure 6.3: New Zealand drowning statistics 1980-2017 and projected population growth. Image credit: Water Safety New Zealand.

Māori and new settler populations

In New Zealand, Māori are over-represented in the drowning statistics (Water Safety New Zealand, 2018a). In 2018, WSNZ convened a meeting to update the organisation's Māori water safety strategy (Water Safety New Zealand, 2018b). One of the main outcomes was a proposal to "establish a Māori Advisory Group that could provide support and advice to WSNZ and the wider sector" (Ibid.). "Māori are most at risk of drowning while collecting seafood, boating, fishing and swimming. Nearly half (46%) of Māori children who drown do so while swimming and 95% of Māori babies who drown…were not [being] adequately supervised" (Drowning Prevention Auckland, 2019c). An example of what is being done to address this are workshops in safe seafood gathering that DPA is conducting (Te Karere, 2018).

With positive net migration in 2017 being double what the natural population increase would have been, more new migrants are living in New Zealand than ever (Stuff, 2018). Some of these people have no water safety knowledge, and many parents do not understand the importance of swimming lessons and survival skill acquisition for their children now that they

are living in a country surrounded by water. Even those migrants from nations bordered by water, like the Pacific Islands, may not be familiar with the hazards that are present at surf beaches, e.g., rips or be aware of maritime rules and safety equipment requirements when boating. Also, the format and style of existing water safety education may not be appropriate for these new communities. Organisations have had to adapt their engagement and delivery methods, therefore, to gain acceptance (Drowning Prevention Auckland, 2019d).

One strategy that has been used with good results is that used by DPA who employ Asian, Pasifika, and Māori aquatic educators that come from these ethnic backgrounds. Staff deliver culturally appropriate water safety programmes and work with the community to identify their own water safety champions, e.g., church leaders or elders that hold a position of influence and respect. A successful example of this is the 'Lifejacket Hubs' that DPA has set up where lifejackets are now available for loan free of charge at various community-based locations (Drowning Prevention Auckland, 2020).

While it would not seem out of place to assert that New Zealand is a world-leader in many aspects of drowning prevention and research, the fact its per capita drowning rate is higher than Australia, USA, Canada, and the UK (Lin et al., 2014) provides some perspective to the outcomes that are still to be achieved by the sector.

Chapter 7. Translation of evidence into practice

In this chapter, I critically reflect on the translation of knowledge into practice. The reflection addresses the question of how to achieve this in a sector where the structure for evidence assimilation and implementation only partially exists. The chapter considers:

- The paradigm of knowledge translation
- Incentives and barriers to change
- Facilitating evidence translation from academia to practice, and
- The call for a system within lifeguarding to rank levels of evidence and grade practice recommendations.

The discussion takes places as it relates to my role as a translator and influencer, the type of evidence, compromise required, and the multi- and transdisciplinary nature of practice. Many comparisons are drawn with evidence translation in medicine and healthcare, which provides a useful starting point, given that drowning is a public health issue.

7.1 The paradigm of knowledge translation

A meeting on knowledge translation and global health held by the WHO in 2005 said that "bridging the know-do gap is one of the most important challenges for public health in this century" (World Health Organization, 2006, p.1). The 'know-do gap' is a "new term to describe an old problem: the gap between what we know and what we do in practice" (Pakenham-Walsh, 2004, p.1189). As the new decade begins, and considering when these statements were made, it is not surprising the WHO has said more recently that "knowledge derived from research and experience may be of little value unless it is put into practice" (World Health Organization, 2019). And as Straus, Tetroe and Graham (2009, p.165) have noted:

> "Knowledge creation (i.e. primary research), knowledge distillation (i.e. the creation of systematic reviews and guidelines) and knowledge dissemination (i.e. appearances in journals and presentations) are not enough on their own to ensure the use of knowledge in decision-making".

There could not be a better example of this than in lifeguarding, where despite the paucity of evidence for practice guidelines, when research has been published recommending a change (Moran and Webber, 2013; Webber, Moran and Cumin, 2019), this does not always

occur until many years after, or not at all. The same is true in other domains, like healthcare, where “a critical concern with knowledge translation is the fact that advances in research knowledge can take years to be implemented into, or change, practice” (Oborn, Barrett and Racko, 2013, p.413).

According to Grol and Grimshaw (2003), 30-40% of patients are not treated using the latest evidence, and care provided to 20% or more of patients is either unnecessary or potentially harmful. It is this issue of translation from knowledge into practice or moving “research from the laboratory, the research journal, and the academic conference [and] into the hands of people and organizations who can put it to practical use” (Wikipedia, 2019), that has led to the paradigm of knowledge translation. It is my view that the following statement is a fair reflection of the drowning prevention sector’s current state:

> “Knowledge translation (KT) is emerging as a paradigm to learn and act towards closing the gap. While knowledge is more than research evidence, [KT] strategies can harness the power of scientific evidence and leadership to inform and transform policy and practice. Although there are ongoing innovations and learning by doing, there is…no comprehensive framework or common platform for…understanding the know-do gap and systems to address it” (World Health Organization, 2006, p.1).

An example of this that has been cited previously is the ILS Medical Committee confirming their target audiences and planning a workstream to update all their position statements to reflect this (International Life Saving Federation Medical Committee, 2019).

At the sector level, ever since the World Conference on Drowning in 2002, there have been calls for more research (Brewster, 2018; World Health Organization, 2014). One aspect that has not been fully considered, however, is how this evidence will be evaluated, and the process for applying it. When it comes to the implementation phase, “real-life experiences rarely follow a straightforward rational or linear pathway. As such, common practice typically favours multifaceted approaches to translation” (Harvey and Kitson, 2015, p.123). Another challenge is the diversity of the sector, different needs in high and LMICs, and the multi- and transdisciplinary nature of those practitioners within the sector who will all apply evidence at their own level, i.e., practitioner, researcher, or policymaker.

The type of evidence, and target audience, as discussed in Section 2.5, are also factors to consider. Traditional forms of evidence within SLS are training manuals and the experience

of senior lifeguards. Written materials can be prone to obsolescence, and simply because a person or organisation has done something a certain way for many years does not make it the safe or correct way to do so. And apart from studies on CPR, surveillance, and physical fitness/ability, there is still a relative lack of scientific research for other aspects of lifeguarding practice. The challenge, therefore, is if the call for more research is answered, how will the sector process this new information considering lifeguarding is only one aspect of drowning prevention. Also, given the contestable nature of evidence, how will any discrepancies that arise between existing knowledge (especially work-based) and current practice be resolved. The possible strategies that will be examined later in the chapter include the use of knowledge brokers; practitioners that work in both academia and operationally, and the development of a framework for evaluating evidence and grading recommendations.

One final aspect to reflect on is whether every intervention or guideline for practice requires an evidence-base to validate it. As a comparison, this question has been asked in healthcare, where not all practitioners agree that evidence-based medicine is the 'holy grail'. A well-known article published in the *British Medical Journal* by Smith and Pell (2003) entitled *Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials* provided an alternative point of view. It stated (about parachutes) "that those who advocate evidence based medicine and criticise use of interventions that lack an evidence base will not hesitate to demonstrate their commitment by volunteering for a double blind, randomised, placebo controlled, crossover trial" (Ibid., p.1460).

The article was satirical and intentionally provocative, but also a serious attempt to highlight not all treatments need to be, or can be validated by randomised controlled trials, and that evidence-based medicine is not infallible. The analogy is worth considering regarding studies that could be proposed to validate lifeguarding interventions, but for ethical reasons could never proceed as those in the control group would have to 'self-rescue', or in a worst-case scenario, be allowed to drown.

7.2 Incentives and barriers to change

Like health professionals, but with notable differences in terms of regulatory oversight, the type of workplace environment, prevalence of paid compared to volunteer staff, and physical

demands of the job, lifeguards work in “specific social, organisational and structural settings involving factors at different levels that may support or impede change” (Grol and Wensing, 2004, p.S58). In health settings, “failure to implement evidence involves factors at different…

Orientation	**1. Promote awareness of intervention** • Level of interest in reading and continuous education **2. Stimulate interest and involvement** • Degree of contact with colleagues • Experience of need for innovation
Insight	**3. Create understanding** • Available knowledge and skills • Ability to remember information **4. Develop insight into own routines** • Attitude (open-minded or defensive) • Willingness to acknowledge gaps in performance
Acceptance	**5. Develop positive attitude to change** • Ability to perceive advantages of change • Opinion of scientific merit of change • Opinion of credibility of innovation source • Degree of involvement in development process **6. Create positive intentions/decision to change** • Perception of self-efficacy; degree of confidence in own skills • Perception of potential problems of putting change into practice
Change	**7. Try out change in practice** • Perception of practical barriers (time, staff, money) • Opportunity to try change on small scale **8. Confirm value of change** • Whether first experiences positive or negative • Degree of cooperation experienced and reaction of patients and colleagues • Side effects (e.g., higher or lower costs)
Maintenance	**9. Integrate new practice into routines** • Willingness and ability to redesign processes **10. Embed new practices in organisation** • Whether procedures in place for constant reminding • Availability of supportive resources • Degree of support from management

Table 6: Incentives and barriers in a proposed ten-step model for inducing change in professional behaviour by Grol and Wensing (2004, p.S59).

…levels of the system" (Ibid., pS58). However, systems contain people. Table 6 describes the barriers and incentives in a ten-step model for inducing a change in professional behaviour. "Effective implementation of evidence and guidelines have shown that strategies that take into account factors at all three levels (predisposing, enabling and reinforcing) are the most successful" (Ibid., p.S58).

Organisations like the ASLSA, now known as SLSNR, have a proud history of innovation and leading change within the movement. Examples of this include the introduction of the first civilian rescue helicopter in the world, jet boats and rescue watercraft (JetSki®), regional radio network, regional communications centre, and duty officers (Surf Life Saving Northern Region, 2019). The issue, in the author's opinion, is less to do with resistance to change, and more to do with the lack of research that occurs within lifeguarding, the process for quality improvement, and, the recurring theme in this chapter, a system for the implementation of evidence and guidelines. Also, the enthusiasm with which surf lifeguards have participated in the studies that I have conducted is a testament, in my view, to the insight and acceptance they have, as described in Table 6. It may also reflect the demographics of the membership, many of whom are studying at educational institutions; the extrapolation being that most of their time is already spent engaged in knowledge acquisition and translation.

At the sector level, the role of governance organisations like ILS and the WHO is not implementation; this is the responsibility of bodies such as SLSNZ to perform at the local level. This is not too dissimilar to ILCOR, who produce treatment recommendations in resuscitation and first aid, but where the actual production of guidelines is done by individual resuscitation councils (International Liaison Committee on Resuscitation, 2019). Barriers to and incentives in healthcare that Grol and Wensing (2004, p.S59) identify at the social (1), organisational (2), and economic and political context (3) levels include:

1. "Opinion of colleagues, culture of the network, collaboration [and] leadership
2. Organisation of care processes, staff, capacities, resources, [and] structures, [and]
3. Financial arrangements, regulations, [and] policies".

Except for care processes (which can be replaced with 'interventions'), these issues are also present in drowning prevention, with practitioners engaged at all levels of The Spectrum of Prevention (Figure 1.4) and at times, competing for resources such as funding.

With an audience for sector outputs that spans from at one end, members of the

public, and the other, policymakers, organisations and government, a body of evidence may be relevant to all groups, but the evaluation of this evidence should, in my view, occur at the level where the intervention is going to be applied. Practitioners involved in primary injury prevention, like government regulators, e.g., Maritime New Zealand should be responsible for ranking evidence at this level. Similarly, evidence for the resuscitation of the drowning victim should be assessed by medical professionals and lifeguards working in the operational space within an appropriate structure, e.g., ILS Medical Committee.

Where evidence pertains to multiple levels of injury prevention, there may be a need for transdisciplinary practitioners like epidemiologists and researchers to advise across all of these layers. This is due to the "lack of skills needed for appraising evidence [that] has been a challenge to all stakeholder groups because, until recently, this skill set has not been a traditional component of most educational curricula" (Straus, Tetroe and Graham, 2009, p.166). In the next section, I discuss my role as one of these so-called knowledge brokers, with an important acknowledgement that I am by no means the only person within the sector acting in this capacity.

7.3 Facilitating translation from academia to practice

A major challenge that any organisation implementing change faces is how best to translate evidence, be that scientific or work-based into practice. As discussed, several factors can have an impact on how easy or difficult it is to implement change. Harvey and Kitson (2015, p.124) provide an excellent description of what is needed in healthcare if "the environment is challenging and unreceptive to change [or] the evidence is disputed, [and] more intensive facilitation is needed to identify the barriers that exist. [This] requires facilitators to have a sophisticated set of skills in negotiation, consensus development and conflict management". The authors make clear that facilitation in this regard is all about "enabling others to act, as opposed to telling, coercing or persuading" (Ibid., p.124). These facilitators are referred to as 'knowledge brokers' (Lomas, 2007; Oborn, Barret and Racko, 2013).

"Knowledge brokers are individuals positioned in such a way that have access to two (or more) discrete knowledge communities enabling them to exchange relevant knowledge across the network of individuals (Burt cited in Oborn, Barret and Racko, 2013). This enables them to absorb knowledge across otherwise unconnected communities or organisational

units" (Ibid., p.421). The attributes and skills of a knowledge broker have been described as:

- "Entrepreneurial (networking, problem solving, innovating)
- Trusted and credible
- Clear communicator
- Understands the cultures of both the research and decision-making environments
- Able to find and assess relevant research in a variety of formats
- Facilitates, mediates, and negotiates
- Understands the principles of adult learning" (Lomas, 2007, p.130).

One of the reasons identified by Lomas (2007) for needing knowledge brokers in healthcare relates to the belief that neither universities or the health service itself provide much of an "incentive for ongoing connections between researchers and clinicians, managers or policy makers" (Ibid., p.131). The same could be said of the water safety sector, where a personal connection with applied practice may lead to an interest or involvement in research. Although some examples of partnerships do exist, for example, University of Portsmouth and the RNLI, and The University of Auckland and DPA (Page et al., 2011; Drowning Prevention Auckland, 2019), these arrangements are typically informal and vested in researchers who belong to both organisations; Dr Kevin Moran and I being cases in point (The University of Auckland; 2019a, 2019b).

The role that I have undertaken in acting as a knowledge broker and trying to close the know-do gap did not come about intentionally. It came about through membership of multiple organisations and working concurrently in the operational, research, education, leadership, and governance fields. Opportunities to bring these groups closer together have, for the most part, been associated with being able to share knowledge between groups through either face-to-face meetings or videoconferences, sharing the results of published studies, and facilitating professional introductions.

Examples of this are for the most part associated with membership of committees like the NZRC Executive, ILS Medical Committee, and IDRA more than any PWDP. One example I can cite, however, is a recent recommendation I made to the SLSNZ First Aid Review Group to introduce CPR feedback training manikins from the start of the 2021 season that was approved (Surf Life Saving New Zealand First Aid Review Group, 2019). Based on research published in lifeguard CPR (Moran and Webber, 2012; Webber, Moran and Cumin, 2019),

recommendations from other credible sources, e.g., SLSNZ's Medical Director, similar studies from healthcare, but also suggesting to the group 'let's just get on and do it', change was effected at this level. The next challenge will be the implementation phase, as funding is needed to purchase the equipment, training will be required for end-users, and the organisation's assessment protocols will need to be updated to accommodate the electronic format of examination results. In terms of making professional connections and introducing or being introduced to others who work in drowning prevention, the WCDP and The Lifesaving Foundation conferences have been the standout events for networking during my career.

When the knowledge broker themselves is also the source of the research or work-based knowledge, this adds another dynamic. While not quite the same as having a conflict of interest (unless for example, the application of the research results in a financial gain for the author, or the author is also a decision-maker within the organisation), the strategy to translate it into practice needs to be different. Having published research in the lifeguarding domain, I understand what it is like to have a vested interest in promoting and seeing it applied in practice. An important consideration, however, for new and emerging researchers who belong to an organisation directly related to their work is that merely belonging to that organisation will not always result in a change of practice. This despite whatever experience, credibility, or influence they may have within the organisation.

There are multiple barriers to implementation at all levels as we have seen, but the correct focus, in my view, is twofold; first, to assist organisations in facilitating the connection between universities, researchers, frontline lifeguards, lifeguard managers, decision-makers, and practitioners who sit outside these formal institutions but have valuable expertise to contribute, e.g., persons that have been rescued or survivors of non-fatal drowning incidents. And second, to ensure all relevant research, not just your own, goes through an evidence appraisal process. Commensurate with this is being prepared for the fact that organisations assessing the evidence may deem there is insufficient evidence to recommend a change in practice or reject the findings entirely. This is considered 'par for the course' and a reality that every researcher will confront, must accept, and then move on from.

Given the nature of change, and significant departure from current practice that this may represent, compromise is an outcome that may appear suboptimal but should be viewed as progress, nonetheless. Knowledge brokers, whose role it is to facilitate the uptake of new research can assist, as included among the desirable skills they should possess are mediation

and negotiation (Lomas, 2007). Compromise, in the author's view, will always be required within the water safety sector when it comes to translating evidence into practice. This is due to differences in funding and resources between organisations, the needs of HICs versus LMICs, competing priorities at the local level, and an inability in some cases to assimilate and evaluate evidence. When practitioners and science disagree, this is where the role of the knowledge broker and their work-based experience is vital. A good example of this is a new MPS from the ILS Medical Committee on when to start or stop CPR (International Life Saving Federation, n.d.). Although the science is clear (Quan, Mack and Schiff, 2014), the practical application of this, for example, to a person who is reported missing in the surf where the exact submersion time is not known and then found, is not.

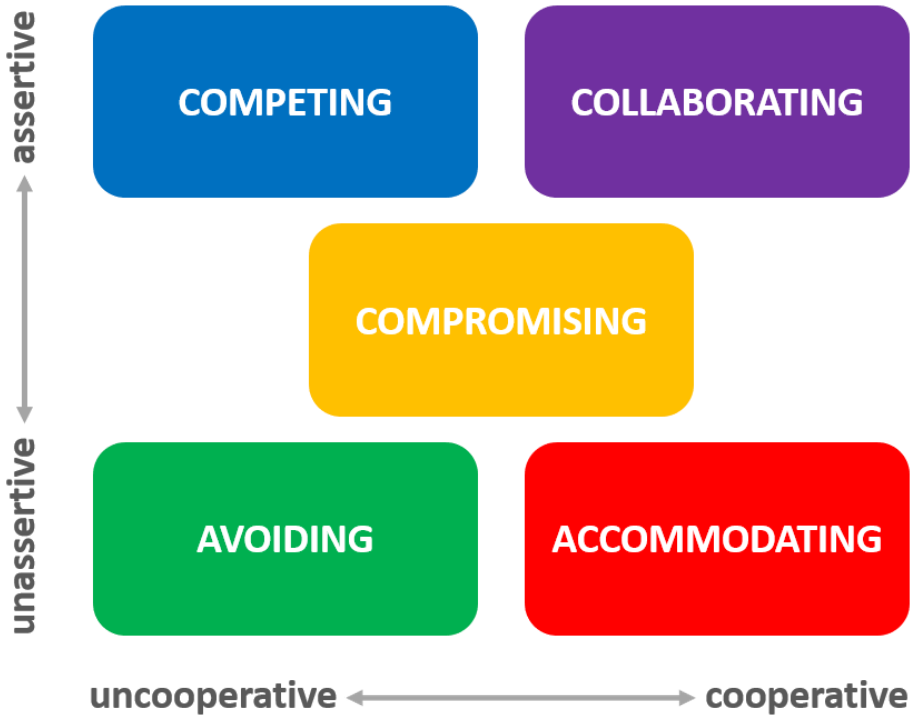

Figure 7.1: Thomas-Kilmann Conflict Mode Instrument.
Adapted from Thomas and Kilman (2008, p.2).

One model that has been devised for negotiation to maximise the outcome for both parties is the Thomas-Kilman Conflict Mode Instrument (Figure 7.1). The model is primarily designed to rank the five modes depicted above that a person uses in a conflict situation. Facilitating the translation of evidence could potentially result in conflict but more likely, in the author's opinion, will result in a decision not to incorporate the knowledge into practice or a call for more information. The relevance of the model, therefore, is in its applicability to

reaching a compromise. A “combination of ‘highly assertive’ with ‘uncooperative’ reveals a competitive negotiation style, where the competitive [party] wins and the other side loses. At the opposite end of the scale, a combination of ‘unassertive’ with ‘highly cooperative’ points towards an accommodating negotiation style, where relationships may be preserved and nurtured, though outcomes not optimized” (Marbella International University Centre, 2018). Best results can be achieved through collaborating, where both parties are assertive about meeting their own needs while preserving the relationship or even improving it (Ibid.). With a call for more evidence to inform the sector (World Health Organization, 2014), it can only be surmised that the need for compromise will gain importance as the body of knowledge in lifeguarding grows, and the efficacy of existing interventions, training methods, and rescue techniques is potentially called into question. Applicability in LMICs may also drive this.

The last aspect that will be considered in this section are organisations that have been established solely to facilitate knowledge translation. Again, these examples come from healthcare. The Canadian Foundation for Healthcare Improvement was formed to “support evidence-informed decision-making in the organization, management and delivery of health services through funding research, building capacity and transferring knowledge” (Canadian Foundation for Healthcare Improvement, 2020). The organisation describes its activities as a knowledge brokering agency as setting the research agenda, facilitating applied research, disseminating research, and getting research used (Lomas, 2007). Leaving aside the tens of millions of dollars this agency receives in government funding, these roles are not entirely dissimilar to IDRA, who lists one of their goals as “to manage, coordinate and disseminate drowning research worldwide” (International Drowning Researchers’ Alliance, 2019). To this end, a role could exist for IDRA providing knowledge brokering services to the sector.

One immediate advantage that this service would offer is someone independent to help organisations facilitate knowledge translation. This may be particularly useful when personal connections with the research or other conflicts of interest exist and a degree of independence is required. Several of IDRA’s members work across multiple disciplines, and either knowingly or unknowingly, are already working as knowledge brokers. Given that it is a criterion of admission that all members must have some involvement in drowning research (International Drowning Researchers’ Alliance, 2020), IDRA could also provide a ‘seeding-ground’ for knowledge brokers within the sector. This, along with other key recommendations from this context statement are outlined in Chapter 9 and 10.

7.4 Levels of evidence and grading recommendations in lifeguarding practice

In Chapter 2, the nature of evidence within the sector and the system for ranking evidence and grading treatment recommendations for ANZCOR was discussed (Tables 1 and 2). Other systems, for example, GRADE (Grading of Recommendations Assessment, Development and Evaluation) are used extensively in healthcare by organisations like ILCOR and the WHO to provide a "systematic and explicit approach to making judgments [that] can help to prevent errors, facilitate critical appraisal…and help to improve communication of this information" (The GRADE Working Group, 2020). Thus, by using a standardised system for evidence appraisal, systems like these are intended to result, ultimately, in better patient outcomes. Currently, no such system exists within lifeguarding and at most other levels within the sector.

It is the author's opinion that creating an industry-specific system for ranking levels of evidence and grading practice recommendations should be developed as soon as feasible. Key organisations like ILS, IDRA, SLSA, RNLI, SLSNZ, and Royal Life Saving should be part of or lead the project. However, as is often the case, there is an imbalance between HIC and LMIC representation on these types of workgroups, e.g., ILS Medical Committee. How LMICs are involved in a project like this is for that reason, an important consideration.

Organisations like Nile Swimmers should be enlisted to provide advice in this regard (Nile Swimmers, 2020), and potential funders, like the WHO, Bloomberg Philanthropies, and the Princess Charlene of Monaco Foundation that have supported other global drowning prevention initiatives should be approached for assistance to underwrite the project (Bloomberg Philanthropies, 2020; Fondation Princesse Charlène de Monaco, 2020). This funding can be used to ensure proper LMIC representation and engage any specialist advisors that may be needed.

Although many similarities can, and have, been drawn with the health system in this chapter, other aspects, such as the ability to conduct randomised controlled trials may not be possible in lifeguarding for reasons that have already been explained. The need for a bespoke system capable of evaluating the available evidence is what is needed, therefore. As will be discussed in Chapter 8, registries to pool data and multicentre studies are required to support this recommendation given the relative lack of data for certain aspects of practice, e.g., airway management in drowning (Baker and Webber, 2011).

Chapter 8. Reflection on practice and personal development

Having conducted a critical review of the PWDPs, considered the local context of drowning in New Zealand, and discussed the translation of evidence into practice, the purpose of this chapter is to reflect on my practice and describe the personal learning and professional development gained through the production of the works. The chapter begins with a review of the reflective model that I will be applying and introduces concepts from a recent study on reflective cycles in work-based research. Given the diversity and breadth of works that I have produced, they will be reflected on together, with selected works cited where relevant.

8.1 Application of reflective practice models

Reflective practice has been described in other professions like nursing as a 'pillar' of qualitative research and is said to improve the reliability of data (Fergusson, Baker and van der Laan, 2019, p.2). Heyler (cited in Ibid., p.3) states that the development of skills in reflective practice "assists with the process of knowing how to learn, and the acceptance of the individual's centrality to their own learning". While I have not engaged in formal reflective practice for many years, I have applied learnings from the production of previous public works to new ones, e.g., The Drowning Timeline.

In Section 3.3, an overview of Gibbs' reflective cycle was presented (Figure 3.1). This model is used widely in healthcare as a framework for reflective writing (New Zealand Nurses Organisation, 2015). According to Lia (2016, p.2):

> "The aims of using Gibbs' reflective cycle are:
> - to challenge your assumptions
> - to explore different/new ideas and approaches towards doing or thinking about things
> - to promote self-improvement *(by identifying strengths and weaknesses and taking action to address them)*, [and]
> - to link practice and theory *(by combining doing or observing with thinking or applying knowledge)".*

One of the main features of Gibbs' reflective cycle is that it incorporates experiential learning into an iterative model. The advantage of this, especially in my practice where multiple

PWDPs have been produced, is the inbuilt reassessment that can occur with each new project or as existing works are revised. Projects may include a formal review at their conclusion; however, this is distinct from individual team members reflecting on their own practice. The application of Gibbs' model will employ a generic approach comprised of the following four steps: description, assessment, evaluation, and action.

In their study *Reflective practice and work-based research: A description of micro- and macro-reflective cycles*, Fergusson, Baker and van der Laan (2019) examined the interface between these cycles as they apply to professional studies in work-based learning. Reflection can occur at the micro, or individual level, and the macro level when applied to projects and programmes. Micro-reflection is described "as 'research', specifically…into the practitioner [themselves], with the practitioner conceived as both the instrument and subject of research" (Ibid., p.6). When reflective learning is applied at the macro level, they state:

> "A professional can (1) reflect, learn, and engage in work and, as a result, (2) be in a better position to scope and plan a work-based project, along with developing a research component, resulting in (3) implementing the project and collecting data on it, which in turn leads to (4) a review and analysis of data and reporting findings, thereby leading to (1) more learning and understanding about oneself, one's workplace, and one's professional practice domain" (Ibid., p.5).

Hence, the model incorporates aspects of both autoethnography and ethnography, as discussed in Section 3.2. The authors also describe a more complex model where prospective research can be undertaken through work-based learning, as opposed to most reflective practice that takes place retrospectively. While any inherent biases need to be controlled for, it is the author's opinion, that with appropriate study design, this model has the potential to improve the quality of work-based research within an industry. The relevance of this study to this context statement can be seen in Chapter 9, where the future impact of the public works, opportunities for more research, and my future role in the sector will be considered.

8.2 Reflecting on practice

So far, the context statement has examined the research methodologies used, personal influencers and motivators, ability to effect change, the nature of evidence and translation, and my role in the production of PWDPs. The focus now shifts to a more personal account of

what it has been like to be involved in the production of public works, how this has made me feel, highlights, challenges, and observations from both an individual perspective and as an MDT member. I attempt to distil the skills and expertise I have contributed as a person to the public works and sector so that opportunities for learning and professional development may emerge. It is intended that the personal reflection will be of benefit to not only me, but others working the fields of lifeguarding, resuscitation, and drowning prevention research.

Getting started

In Chapter 2, I discussed how I came to be involved in SLS and the various roles that fostered my interest in first aid, emergency care, ambulance, and drowning prevention. With a dose of courage, sense of the unknown, and personal motivation to fulfil my career aspirations, in the early 1990s, I attended my first local and international conferences. I remember attending Medic 90 in Auckland and the Spark of Life in Melbourne. At the time, it felt like I was the youngest person in the audience by 20 or 30 years. I travelled to these events on my own and hardly knew anyone else who was there. I also remember having a sense of 'perhaps I shouldn't be here' and that all eyes were on me.

However, it was having that courage, motivation, and determination to experience a new learning opportunity that allowed me to hear industry experts first-hand, aspire to follow in their footsteps, and in time, interact and work with them on a professional level. A career highlight was being invited as a keynote speaker to present on drowning at the 2015 Spark of Life in Melbourne (Webber, 2015a, 2015b); this, some 20 years after I first attended the event as an out-of-place feeling 20-something year old. Delivering these presentations with the innate confidence in my ability as a recognised expert and capable public speaker in 2015 was a very different experience to when I nervously walked up to the podium to address the NZRC Conference at my first major speaking engagement in 2004 (Webber, 2004). While not everyone is confident in public speaking or media relations, it has been my experience that without these skills, the effect and reach of a public work may be limited.

My initial foray onto the international drowning prevention stage was in 2007 at the World Water Safety Conference in Porto (Doyle and Webber, 2007). This was the first time my work had been presented. I remember asking for assistance from fellow author Billy Doyle to write the abstract as this was something I had only done once before. At this time, I was somewhat disconnected from SLSNZ so presented under the name of my company, AquaSafe

New Zealand, and on behalf of PALS. Despite this, the SLSNZ Lifesaving Manager at the time, Brett Sullivan, involved me in all the activities along with the other New Zealand lifeguards that were attending the event. From this, essential learnings in collaborative working within a small country and industry, what it feels like to be isolated or alone at an international conference, and the actions that as both a person, and in my case now a sector leader can be taken to include other delegates, and thereby make the experience more positive for them, become clear.

With the ILS Medical Committee, I first sought permission to attend their meeting as an observer during the 2011 WCDP in Da Nang (International Life Saving Federation Medical Committee, 2011). Some concern was expressed at this request by the chairperson who wanted to preserve the 'sanctity' of the meeting as a doctors-only forum. I remember thinking at the time this was unusual, as by this stage in my career, I had already amassed 20 years' experience in treating drowning victims as a surf lifeguard. I had also been teaching advanced life support to medical students, doctors, and nurses for over ten years, as well as having worked on a frontline emergency ambulance. It was the first time I had ever been exposed to professional silos, a philosophy of working that MDTs have attempted to erode, especially within the healthcare sector (Iliffe, 2008).

One event that stands out more than any though is The Lifesaving Foundation's 2012 Drowning Prevention and Rescue Conference (The Lifesaving Foundation, 2012). This biennial conference, held in Ireland, is a live-in event where all delegates typically present, attend all sessions, and dine together. The intention is to provide multiple opportunities for delegates to meet, network, and discuss their research/work without the time-constraints that usually exist at other conferences. Social events are interposed with the scientific programme, which gives even more opportunity for delegates to interact. It was at this conference that I first got to meet many of my esteemed co-authors such as Dr David Szpilman, Professor Linda Quan, Professor Mike Tipton MBE, and Professor Joost Bierens. This event was also the location for the inaugural meeting and genesis of IDRA. I doubt that I would have had the opportunity to work alongside these world experts if I had not attended this, and subsequent Lifesaving Foundation meetings.

During my career, I have been fortunate to receive financial assistance from several organisations as well as investing my own money into attending international events. Without this assistance, it would have been difficult for me to complete some of the PWDPs had I not

been able to attend face-to-face meetings. As discussed in Section 5.3, virtual meetings and electronic forms of communication are not useful/appropriate in all settings (Rhoads, 2010). Therefore, the role of a global drowning prevention practitioner requires frequent travel and secure financial backing to underwrite the cost. This presents an immediate impediment to participation, especially for volunteers, who make up most of the human resource for many water safety organisations and NGOs, and people from LMICs.

For practitioners in New Zealand, the geographical location of the country also presents an obstacle in terms of increased travel costs, and the time it takes to get to other parts of the world. For visiting overseas practitioners, it is not until they have spent the 24-plus hours on a plane that they realise just how far away New Zealand is. This isolated location in the South Pacific Ocean gives rise to the hazardous beach conditions such as large surf, rip currents, and holes that are often encountered. The capabilities, resilience, and tenacity that New Zealand lifeguards require to operate in these conditions is one reason, in my view, they are held in such high regard globally.

A discussion on how I joined the conference circuit and the ILS Medical Committee is essential, therefore, when reflecting on my involvement in producing PWDPs. It was these events that allowed me to meet some of the most expert and influential leaders in my field and led to invitations to participate in future public works. I am sure that these experiences inspired me to follow the professional pathways that I have chosen in life, assisted in getting paid and voluntary work, and provided opportunities for travel and personal/professional development. Hence, conferences have played a significant part in my career history, not only as an avenue to present PWDPs and produce new ones, but also to establish an industry presence and professional networks.

Production of public works

The majority of PWDPs submitted in this context statement had their origin in either a work-based experience (where an opportunity to improve a system or process became apparent during reflection on a critical incident or training session) or in response to a known industry-wide knowledge gap. It is this originality, which comes from 'being in the moment' that allows for the cognitive skills of: analysis, synthesis, and evaluation; self-appraisal and reflection on practice; research and development; (and) evaluation to be demonstrated at the doctoral level (Maguire, 2012, pp.18-20).

In Chapter 3, I described using both an autoethnographic and empirical research approach depending on the type of study. The Sentinel System for Response to Drowning provides an example of where elements of the layered accounts and grounded theory methods of empirical research were applied. This model, which was my first PWDP, originated from a discussion with co-author Billy Doyle about a situation that we had both observed on active duty where we felt an opportunity to improve lifeguarding practice and outcomes for drowning victims existed. I knew that whatever we devised had to be logical, simple, and easily applied by lifeguards. If it were to gain acceptance, it would need to link to and extend the existing body of knowledge on this topic.

What is interesting about Sentinel is that it involved an inductive and deductive approach as it was developed. It was fortunate at the time that the television series *Piha Rescue* was being filmed and we had access to footage of real mass-rescue situations for analysis (TVNZ OnDemand, 2019). We noticed several aborted pick-ups of drowning victims when the inflatable rescue boat was used, and persons with a low threat to life being rescued before those with a higher threat to life. This gave rise to a central theme of Sentinel, which is buoyancy support, and this concept is now the central link in the Drowning Chain of Survival. As operational lifeguards, we were able to see first-hand and reflect on incidents at the time they occurred and discuss the rationale for lifeguards' decision-making with them while it was fresh in their mind. Although this level of inquiry was relatively informal, it allowed us to 'sense-check' the model as it developed. Of all my PWDPs, Sentinel is the one that has been most profoundly influenced and shaped by work-based experiences as an active lifeguard.

The relevance of research outputs to the end-user was identified in Section 1.3 as a core theme informing this context statement. An example of this is provided in Appendix F. Having the opportunity to test a model or research instrument before the study commences, or the PWDP is published, can improve the value of the final product, and identify problems at an early stage. In the case of qualitative and quantitative research, it may also reduce the error rate and improve the validity of data. This, for example, could be due to respondents not understanding a poorly worded question, or from incorrectly assigning a numerical value to a variable. Mistakes in study design and research methodology can be costly, and in some cases invalidate the work. I have been fortunate during my career, therefore, to have had unfettered access to the knowledge and guidance of experienced researchers like Dr Kevin Moran, with whom I published my first study.

Another aspect of producing PWDPs that I have found particularly rewarding has been conducting field research. It has provided me with the opportunity to engage with frontline lifeguards in their place of work. The ability to speak in person to the lifeguards who may have to apply or incorporate aspects of PWDPs into their practice has been invaluable for two reasons. First, it confirms the most critical aspect, the research question, is going to address the hypothesis being tested. Second, it ensures that even if the researcher is not a lifeguard they at least have an appreciation of the workplace, which includes such things as the environment, facilities and equipment, geographic location, staffing levels, distance from help, and any other information that may be relevant to the study, e.g., access to CPR training manikins. It can also stimulate interest from those being studied to enter the academic field. This will ensure a crucial aspect of ongoing organisational and sector improvement is not just vested in the current generation of researchers.

While some researchers might struggle to enrol participants in studies, with surf lifeguards, my experience has been the opposite. Whether this enthusiasm stems from the research subjects' age (typically <25 years), the subject of the study, e.g., CPR or a culture within the organisation that recognises research findings often identify areas for system, team, or individual improvement and should therefore be encouraged, I am not sure. What I do know, however, is the keenness of these lifeguards to take part has made reaching our sample size targets relatively easy. It has been gratifying also that when the results are published, clubs and lifeguards have been interested in reading them, and want to know what changes will be implemented.

In addition to the work-based experience that I have been able to apply in the production of public works, there are other skills and attributes should be reflected on. I have always had an eye for detail, and this has been both an asset and a liability when it comes to proofing documents for publication, being part of an MDT, reviewing raw data, or agreeing upon an infographic design. While perfection is what I have always strived for, I have had to accept that mistakes will occur, and there is a need to see the 'big picture', as opposed to focusing on minutia. Although not artistic, this eye for detail makes me acutely aware of any flaw or imperfection with a piece of work. Ensuring the layout and formatting of publications is correct, I believe is a help, as opposed to a hindrance when it comes to PWDP production. I do accept, however, that some colleagues may view this as delaying the production process, and this is something I need to be aware of.

Had I not been supported and mentored during the formative stage of my career as an emerging researcher, I would likely have made more mistakes. In recent years it has been rewarding, and almost an unwritten rule or responsibility to respond to requests from other researchers and provide them with advice or information, just as I have been grateful to receive this so that they too are successful in their professional and academic careers. Part of this responsibility, has in recent years, involved agreeing to review other authors' work at the invitation of journal editors. Having an enthusiastic pool of volunteer lifeguards who are prepared to pilot-test surveys is also something that I have been fortunate to have at my disposal. I believe that reference groups such as these improve the quality of data and overall validity of the research. Also, this type of testing is an expected academic standard.

When I reflect on being a member of an MDT, which has been the case for most of my PWDPs, several responses emerge. Early in my career, I saw being asked to take part in these teams as a privilege and did not give myself full credit for the reasons why my input and expertise were being sought. I was acutely aware of a hierarchy in terms of the experience and reputation of other team members. I would later discover that this perceived hierarchy was probably linked to me not having the professional standing of my colleagues, or lacking confidence in my qualifications and experience.

That said, in any MDT, there are always going to be different views and opinions, levels of experience, and even competing interests that may be personal, professional, or financial. While I cannot recall any specific examples, I am sure that other team members and I have at some point been affected by these, some of which are of an innate human nature. Ensuring conflicts of interest are disclosed and managed, therefore, has become a standing item on most organisations' meeting agendas, with guidance available on how they should be handled (Office of the Auditor General, 2007).

Despite some of the challenges that come with teamwork, it has always been my preference to work alongside others. This is so the combined experience of the group can be engaged for the specialist skills that they can contribute towards the overall production of a PWDP. An additional benefit is that the workload can be divided up, and in my experience, this can reduce the time needed to complete a project, especially when it comes to writing a research paper. There have been times when this is not the case, and this has resulted in some friction within the group, or in rare cases, a team member being excluded as an author. Very few researchers in drowning prevention work in a paid capacity, however, so allowances

must be made for other aspects of daily life that will at times take precedence to voluntary activities such as PWDP production and volunteering for NGOs. In Section 1.3, various factors were identified that is reducing the amount of time volunteers have available to commit.

One of the issues I have faced in producing PWDPs as part of an international MDT has been working with colleagues who speak English as a second language. Least difficult has been the face-to-face meetings, where miscommunications can be clarified immediately. However, as discussed in Chapter 5, one of the hardest aspects has been the co-writing of documents remotely, especially manuscripts submitted for publication in scientific journals. At times, this has led to frustration as I have struggled to decipher what is being said, or harder still, the context of what is being communicated. These experiences have, however, led me to develop a high degree of empathy for my co-authors and be far more understanding of the difficulties they face when writing in another language or presenting at a conference.

To this end, I have tried to assist colleagues by offering to proof their slides and being present in the audience to reassure them. Whenever I chair a conference session, I try to ensure these speakers feel supported and remind myself of what it was like before I became a confident public speaker. In some cases, this has involved asking a colleague who speaks their language to be present and interpret if required. Providing this level of support is crucial if the sector wants to be genuinely inclusive, and recognise the work of non-English speaking practitioners and countries that have a valuable contribution to make.

On a similar theme, another issue that I have recently started to reflect on is the relevance and applicability of my PWDPs to LMICs. There is an inherent flaw, in my view, in trying to apply drowning prevention strategies to LMICs if you operate in a HIC and have no understanding or knowledge of the challenges that practitioners working in these countries face. For this reason, many international workgroups and committees are addressing this by ensuring they have LMIC representation.

Whereas previously, the applicability of a PWDP to a LMIC would have been an afterthought, it is now something that is considered at the outset. An example of this is the Drowning Chain of Survival, where the model can be applied in any aquatic setting. For example, no equipment, only training, is needed to provide resuscitation, and flotation does not need to take the form of a commercially manufactured life ring; empty soft drink bottles, plastic containers, or foam rubber off-cuts often have enough buoyancy to support a drowning person (Supawerakul, 2019).

Having been involved in the establishment of coastal lifeguard services in Pakistan, I experienced first-hand how to assist a LMIC. One of many things I learned from doing so was the importance of ensuring these organisations have their own voice. While I have previously spoken on behalf of PALS, it has always been more impactful when they have been able to do so themselves. Having representatives from LMICs able to attend conferences and meetings in person also helps forge professional networks and friendships, and this is the fabric that unites the industry in its common goal. It should be noted though, that not every PWDP will be suitable for LMICs and this is not a failing, as there will be other public works which are not relevant to HICs.

The equipment that was donated to PALS, although not new, was in a serviceable condition, fully functional, and training was provided in the correct use of it. A concern that has been expressed by the WHO about donations of medical equipment to LMICs in their publication *Medical device donations: considerations for solicitation and provision*, is whether the equipment is fit for purpose, meets local regulatory requirements, can be serviced, and if training is available for staff (World Health Organization, 2011). Sometimes, this equipment remains unused or discarded years after donation.

While I cannot cite any specific examples within the water safety sector, there are anecdotal reports of obsolete lifesaving equipment or outdated training manuals being donated to LMICs. There is an opportunity, and I would argue duty, for organisations like ILS to do what they can to stop this from occurring by putting in place a directive or voluntary code of conduct amongst its member federations. Oversight could be provided by the ILS Rescue Commission, who could, for example, approve or decline any donation of equipment in advance of the consignment being sent.

Use of autoethnography

The most appropriate reflection on the use of autoethnography originates from the writing of this context statement and PWDPs like Sentinel, which applied a grounded theory form of autoethnography to develop the model iteratively as more work-based experiences were encountered. Autoethnographers, according to Adams, Ellis, and Jones (2017, p3.) “offer accounts of personal experience to complement or fill gaps in existing research. The second purpose of autoethnography is to articulate insider knowledge of cultural experience”. As autoethnography focuses on personal experiences that “cannot be captured through more

traditional research methods" (Ibid., p.4), I have been able to write about and present my findings from 'being in the moment' in the form of PWDPs, and in conference presentations (Webber, 2016) or lifeguard training sessions. This has been especially advantageous when talking to groups on human factors, an emerging area of interest for which there is a lack of information in SLS. Human factors is "the application of what we know about people, their abilities, characteristics, and limitations to the design of equipment they use, environments in which they function, and jobs they perform" (Human Factors and Ergonomics Society, 2019). This discipline stems from the military and aviation fields, and more recently, has been integrated into healthcare to improve patient safety.

Figure 8.1 shows me (yellow arrow) at an actual drowning incident where global and national practice was influenced. This was the first time that an i-gel® airway had ever been used in drowning resuscitation.

Figure 8.1: Drowning resuscitation scene at Piha Beach where an i-gel® airway is about to be inserted by the author (yellow arrow) and paediatric defibrillation pads (red arrow) were inadvertently applied. Photo credit: Geoff Calvert.

The experience was documented in a case report and called for more research on the efficacy of these devices in drowning (Baker and Webber, 2011). The first lifeguards to arrive on-scene also unintentionally applied paediatric defibrillation pads (red arrow) to an adult patient. There was no adverse effect on the patient as they were in a non-shockable rhythm, i.e., a rhythm on the electrocardiograph that cannot be treated with a defibrillator. This led to a change in practice at my request, where all paediatric defibrillation pads in SLSNR were

removed from service to prevent this from happening again. While the technical learnings from this incident were valuable, what autoethnography adds is the ability to describe what it was like to be a member of the team. Other feelings associated with, in this case, a drowning victim that could not be revived, and discovering after the event there had been equipment-related issues, can also be examined.

While reflective practice is well established in other professions like nursing, it has not been used in lifeguarding. I believe that there is scope to do so and help lifeguards make greater sense of the non-technical aspects of their work-based experiences. My ability to affect change has come, therefore, through experiencing critical incidents and routine operations at many levels: personal as a human being; societal as a member of the community; clinical as a health professional; managerial as a team leader; technical as a resuscitation educator; emotional as a critical incident debriefer; (and) scientific as an academic and researcher.

These experiences have either individually or collectively resulted in a change to my practice, my view of the world in respect of a topic, or added to the body of knowledge. By evoking a response in the reader or audience and inspiring them to reflect on their practice critically is one of the goals of interpreting autoethnographic accounts (Peterson, 2014). This is something that I have attempted to do when presenting PWDPs or drowning-related topics at conferences. One strategy I have used to achieve this is the use of video clips from the *Piha Rescue* television show. These clips, often raw and dramatic, provide a sense of reality to the environment in which the public work may have to be applied, or reflection is sought.

More on human factors

For over ten years, a popular reality television show, *Piha Rescue*, was filmed at the beach where I work (TVNZ OnDemand, 2019). The footage provided an insight that I might not have gained without the ability to rewind and replay scenes. Not only was I able to reflect on what had happened from a technical lifeguarding perspective, but some of the group and cultural dynamics that impact on human factors and teamwork could also be studied. I was able to show other lifeguards aspects of the culture, hierarchy, and dynamics within a team, errors and mistakes, and examples of interpersonal communication and decision-making under duress for them to critically review.

As many of these incidents captured on video featured me as a member of the team,

this added to my emotional credibility and vulnerability as the author/presenter. Peterson (2014) asserts that engaging with the reader (or audience in this case), for them to emotionally connect with the experience and enhance their ability to reflect is one criterion by which the effectiveness of an autoethnography can be assessed. Documenting these experiences, and those of other lifeguards forms the basis for my next major project, *In Plain Sight* (Doyle and Webber, n.d.), a textbook on human factors in lifeguarding.

St. Pierre, Hofinger and Simon (2016, p.21) in their text *Crisis Management in Acute Care Settings* state "the most frequent human errors in healthcare include judgement errors, communication failures and lack of teamwork. Human factors provide the potential to trigger critical situations, as well as the skills to master them". Like healthcare, drowning incidents typically occur in a high-stakes environment, but with the added complexity of environmental hazards, which pose a risk to victim and rescuer safety. Several subdomains of human factors have relevance to lifeguarding, and these include vigilance, concentration, divided attention, and attentional capacity.

Vigilance is "the ability to remain alert and watchful for extended periods of time and react appropriately to occasional stimuli" (Ibid., p.164). This is what lifeguards do when supervising swimmers at a patrolled beach or other bodies of water, e.g., lake or waterpark. "Concentration depends on the ability to pay selective attention by which disturbing stimuli are blocked out and a conscious selection of relevant stimuli is made" (Ibid., p.165). These two statements describe the complexity of what lifeguards do when trying to separate victims in distress/drowning from those who are not. Performing multiple tasks or distractions, e.g., watching the water and completing an incident report form may lead to divided attention and compromise the execution of one or both tasks. The authors propose a 'Bucket Theory' that asserts everyone has a maximum level of attentional capacity. This "cannot be enlarged at will, but it can be managed differently" (Ibid., p.167).

While some research has been conducted on lifeguard vigilance (Page et al., 2011), it does not have strong links to decision-making in teams and other human factors, especially during the crisis phases when a drowning person is identified and requires urgent rescue. It is the author's view that the opportunity exists to conduct further research into human factors in lifeguarding using either autoethnography or a blended approach that incorporates other research methods.

The final aspect that I will reflect on, therefore, is the blending of the various research

models described in Chapter 3 into the production of PWDPs. One of the challenges in writing this context statement has been the variety and number of PWDPs that I have had to present, critique, and reflect on. The research methodologies used have not been uniformly applied across all the public works, with most requiring a combination of strategies. While *Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards* employed a deductive form of empirical research and positivism, others, like Sentinel, used an inductive approach, relying more on realism and interpretivism.

These methods did not provide a complete picture though to describe the complex personal and interpersonal factors involved in critical decision-making as part of a lifeguard team. For this reason, aspects of the layered accounts and grounded theory methods of autoethnography were employed to help describe the human factor and cultural aspects. Before undertaking this course, I had not considered how the PWDPs related to various research methodologies. Establishing these links now provides the basis for more robust study design and may improve the validity of future research outputs.

On a purely humanistic level, it continues to be a privilege to work alongside like-minded, dedicated professionals who volunteer their time and energy in pursuit of the common goal; zero preventable drownings. Although this goal is highly aspirational, and perhaps seemingly unattainable, it has inspired me to continue producing PWDPs that will address this complex problem in a logical, tangible, and easily applied way. It is essential, therefore, that this vital work continues, and that succession planning occurs. This will ensure that our young and emerging practitioners can build on the achievements to date, and no momentum or industry knowledge is lost when responsibility is handed over.

8.3 Personal learning and professional development

So, what are the personal learnings and professional development that I have obtained from producing PWDPs? I have been very fortunate to travel the world extensively, take part in drowning prevention initiatives and attend conferences. Having enjoyed these benefits, the onus now falls on the organisations that I belong to and me to make sure these opportunities exist for other lifeguards and emerging researchers from LMICs or countries that do not have established lifeguard, ambulance, or rescue services. The legacy of events like the WCDP is that these people must be financially supported and encouraged to attend. This will go some

way to safeguarding these meetings as not just representative of HICs and those with financial support, but more importantly, those countries where the burden of drowning is highest and resources scarcest.

The opportunities that I was afforded have allowed me to make a career out of doing something I am passionate about. I believe that this work has made a positive difference in reducing drowning and improving outcomes for survivors, their family, and the community. Removing any barriers to other individuals who may want to follow this pathway is imperative for the future of the profession and continued impact of New Zealand lifeguarding practice on global drowning prevention. In this regard, I was active in lobbying SLSNR and SLSNZ to provide funding for up-in-coming volunteers to attend the 2019 WCDP. Suggestions that I have made to the SLSNZ Board include setting up a legacy fund in honour of an SLSNZ life member that was heavily involved in ILS governance who recently passed away and offering to make a donation from my own company to 'kick-start' this or another fund.

In a similar vein, having once been a new and young member of an MDT has made me aware of how these people may feel when first faced with working alongside more senior team members. PWDPs must always be 'real-world relevant' so that lifeguards can relate to, and have confidence in them. The best way to achieve this is by having them participate in their development. This should take place in an open, inclusive, and supportive environment. Several references have been made in this context statement to validating the relevancy of the PWDP to the end-user. Not only have I had to make this point to more senior colleagues, but I am cognizant that I am no longer in the age-group of most lifeguards. Consequently, my view of the world may not fit with theirs.

The only way to address this is to ensure frontline lifeguards are encouraged to participate in MDTs and that their work-based experience is acknowledged for the value it adds. Another critical aspect is implementing a feedback mechanism where members can provide suggestions for improvement. Organisations must ensure these communications are acknowledged and responded to promptly. SLSNR is an example of an organisation that has an annual innovation award to reward original thinking. This has proven to be an effective strategy for motivating lifeguards to come up with their own solutions to a problem.

A feature of personal learning that is essential to pass on to new practitioners is that not every PWDP will be deemed a success, and perceived (or actual) failures, such as having an article rejected by a journal are to be expected and not necessarily a reflection on the value

of the work, or a slant on the efforts of the individual or team that has produced it. At times, a public work may be published but not adopted into practice. When this occurs, researchers should remind themselves that contributing to the body of knowledge is still a commendable achievement. As was the case with Sentinel, other parts of the world may use the work before the country of origin does, and this should be seen in a positive light. That said, it has taken me an entire career not to take this type of rejection too personally.

Additional skills that I have developed through the production of PWDPs are analytical thinking and academic writing. Analytical thinking has been defined as:

> "The process of gathering relevant information and identifying key issues related to this information. This type of thinking also requires you to compare sets of data from different sources; identify possible cause and effect patterns and draw appropriate conclusions from these datasets in order to arrive at appropriate solutions" (IQ Doodle School, 2019).

The way that I have gathered information has utilised traditional methods of scientific inquiry and through the critical analysis of work-based experiences. For some PWDPs, this is followed by modifying practice or testing new protocols in the field. Having the ability to evaluate evidence in the various states it exists, while at the same time remaining objective and controlling for any biases that may be present has, therefore, been an area of significant professional development for me.

As a lifeguard, but also a researcher, the ability to develop skills in academic writing has been pivotal in getting my works into the public domain as well as subjecting them to the review process that in part assures readers of the validity of the results. As discussed in Section 2.4, I was fortunate to embark on my academic writing career with the guidance of Dr Kevin Moran, one of the most prolific publishers of water safety and drowning prevention papers worldwide. As a co-author, I was able to gain valuable insights into the publication process from start to finish.

Throughout this process, however, there can be pitfalls along the way. I would recommend that new researchers try and co-author several publications before they 'go it alone'. As most journals have word limits and formatting/referencing styles on original articles, editorials, and letters, I have had to modify my writing style and develop editing skills to comply with these requirements. These skills are highly transferrable, and I am confident

that academic writing has improved my written communication in all aspects of my personal and professional life. As my main outputs are in the field of academic research, maintaining and improving competency in this area is essential, especially as an emerging knowledge broker within the sector.

From an applied lifeguarding practice perspective there is still a great deal of work to be done to understand how lifeguard teams' function, and to conduct work-based research to validate existing, and test new methods of beach surveillance, drowning resuscitation, and surf rescue. As discussed in Chapter 7, there is an urgent need for a system to rank evidence and grade recommendations of practice in lifeguarding. The creation of such a framework may encourage organisations like SLSNZ to take a closer look at how they translate evidence into practice.

Through completing this context statement, the role of autoethnography as a means of producing research has emerged as providing opportunities for gaining new insights and knowledge into human factors, and other relevant topics, e.g., the stress response to critical incidents in lifeguards. The ability to extrapolate findings from other industries is limited, as the environment that lifeguards operate in is uncontrolled, and the skillset required diverse. There is a need, therefore, for ethnographies to come from within the profession.

While the likes of SLSA and the RNLI have a research department and funding set aside for this type of work, the same cannot be said for SLSNZ. Indeed, none of the SLS research that I have conducted has been funded, and some aspects have incurred a personal cost. Being able to trial new methods at a local level, however, has allowed me to take proposals to SLSNR or SLSNZ with some preliminary results to either support the initiative or suggest a change to the study protocol for more significant, e.g., national trials. This has the advantage of not only making more efficient use of resources and preventing unnecessary or futile studies but at the same time, not discouraging new ideas or innovation.

Although neither I nor my co-investigators have undertaken this research with a view to getting paid, those entering the field should be aware that there can be an opportunity cost of time lost in paid employment spent volunteering on SLS and drowning prevention projects. As financial reward has not been my primary motivator, for me, this has not been an issue. Nonetheless, it would be prudent in my opinion for SLSNZ to create a research fund and to consider following the lead of WSNZ in establishing a Masters Scholarship in partnership with a local university or academic institution (Drowning Prevention Auckland,

2019). Providing a modest funding pool, e.g., $5,000 towards small-scale research and innovation projects for lifeguards who have not undertaken this before could also stimulate interest and assist with succession planning.

Working within an MDT, especially those of a multinational nature has provided me with some of the most significant learning opportunities in my career. The motivating factors, cultural considerations, and language barriers that may exist have already been discussed. However, it is how one responds to, accepts, and manages these differences that is the defining factor. I have learnt to compromise, respectfully hold my view, accept the majority rule, and learn acceptance and tolerance of other cultures. This process has been made easier because all team members share a common purpose. At times, there have been competing interests, but as described earlier in this chapter, how these issues are managed is now more overt and transparent.

On the rare occasion that conflict has arisen, these moments are short-lived as points of difference are seldom personal, and the team members I have worked with are all articulate in describing the justification for their stance on an issue. Central to this is the chairperson or leader of the MDT. The person who is selected for this role must possess a broad skill set to ensure all team members can contribute, and full respect is afforded to every delegate, culture, and opinion throughout the production process of the PWDP. The leadership of any team should not be in perpetuity; hence appointments should be for a set period, e.g., ILS sub-committee appointments are for a 4-year term.

Several references in this context statement have been made to the lack of LMIC representation on many of the international workgroups that I belong to. Although some steps are being taken to address this, e.g., scholarships to the 2019 WCDP for LMIC delegates (World Conference on Drowning Prevention, 2019) there remain significant gender and ethnic diversity issues with lifesaving. Males from HICs dominate most committees. In New Zealand, Māori and other ethnicities are the least visible members of SLS clubs, yet there is no strategy to address this. There is much work to be done, therefore, to improve diversity and the inclusion of women on committees and as leaders of task forces in drowning prevention.

At the 2017 WCDP in Vancouver, a Twitter campaign was run to create a list of the 36 leading women in drowning prevention. “The aim of the list…[was to] increase [the] visibility of women working in drowning prevention, highlight the contribution of women in advancing both research and practice, and to offer role models to young women” (#WDP36 – More than

a popularity contest, 2017). After the list was published, several people asked what they could do to support women in their organisation and increase their representation in leadership positions. This led to the five actions to actively support diversity being developed (Figure 8.2), and the launch of a diversity pledge for drowning prevention practitioners to sign.

Figure 8.2: The Diversity Pledge: Five steps to becoming an ally, whether to women, people of colour or other groups underrepresented in leadership. Image credit: SOBRASA.

While there are other aspects of personal learning and professional development to extrapolate from the production of my public works and operational experience, the ones I have focused on in this chapter offer the most applicability for others in the profession and my future roles within the sector. The final step of Gibbs' reflective cycle is action. The actions that I will be taking from reflecting on my practice include:

- Continuing to seek answers to those research questions yet to be answered
- Formalising work-based experiences into research projects
- Use of autoethnography to improve practice and share cultural knowledge
- Reviewing existing PWDPs to confirm they are still relevant
- Promoting diversity within workgroups that I am part of, and
- Identifying successors.

Many of these actions can be achieved by just supporting new and emerging lifeguards and researchers to participate in committees and conferences that I am involved with. Others, however, will require a more formalised plan, and this becomes a personal challenge to develop for the next phase of my career. Some early examples of these actions include a study that I am conducting during 2019/20 entitled *Body recovery times of drowning victims at New Zealand beaches: A ten-year retrospective analysis* and an upcoming article on human factors that includes an autoethnographic account, *Towards a "Rescue Ready" mindset: Can lifeguard teams learn lessons from the attributes of chronic unease?* (Doyle and Webber, 2019). An invitation has been extended to the Women in Lifesaving Network to have a representative on the ILS Medical Committee (International Life Saving Federation Medical Committee, 2019). I also intend to use my influence to lobby for the development of a new system for ranking levels of evidence and grading recommendations in lifeguarding practice.

Chapter 9. Future impact of the public works

This chapter addresses the question of what I see as the future role of the PWDPs. For those PWDPs, especially ones published in the early 2010s, suggestions for new research or projects that build on the original work is provided. Opportunities for other lifeguards or professions to take part in, or even take over this process are also discussed.

Drowning prevention models and reaction mnemonics

The Drowning Chain of Survival (Figure 1.1) should be used more extensively in water safety courses and other forms of aquatic education, e.g., surfing lessons. This has been successfully demonstrated in Brazil (Figure 5.4). In New Zealand, it should be part of all first aid training given the abundance of water hazards in the country. It may also help address the problem of aquatic victim-instead-of-rescuer syndrome. Lifeguard services and local authorities can use the model as their framework for beach operations and justification for funding now that the ratio of preventative actions to rescue and resuscitation attempts has been established (Szpilman et al., 2018).

Similarly, the Drowning Timeline (Figure 4.1) can be quoted by water safety agencies and government in their injury prevention policies to provide a sound basis for community-wide drowning prevention as both models are founded on established injury prevention frameworks (Haddon, 1999). For countries, states, or regions that do not have a water safety plan, models such as these mean they do not have to 'start from scratch'. An opportunity exists to apply this model and identify any gaps that may exist in either the model itself or the national/regional water safety plan.

My vision for the 4Rs of Aquatic Rescue (Figure 4.2) is for more water safety educators and swimming instructors to use it as part of their swim and survive programmes, and that the media refer to it whenever they report on the public attempting water rescue, especially if there has been a fatality. There has been some reluctance from the media to do this, and I think there are two reasons; first, they do not want to appear to be criticising the actions of the rescuer. And second, they are unaware a series of actions has specifically been developed for these situations that can reduce the risk to the would-be rescuers and improve the victim's chance of survival. There is an opportunity, therefore, to engage with public relation advisors prepared to assist in working with the media to ensure these messages are routinely included when reporting on these incidents.

One strategy I have already employed to increase the use of these resources is to promote them to audiences during conferences and making these presentations, along with links to the models and supporting information freely available for download (Association of Emergency Care Training Providers, 2019).

Drowning data collection and patient care guidelines

An issue identified with data collection, apart from those discussed in the previous chapters, is the lack of centres where large numbers of non-fatal drownings and resuscitation attempts are accurately recorded. One of the reasons for this is that in HICs like New Zealand, lifeguards perform relatively few drowning resuscitations annually (Webber, 2010). This is partially due to a paradigm shift in lifeguarding from a reactive style of patrolling to one that is more focused on prevention.

The most extensive database of these events comes from Rio de Janeiro (Szpilman, 1997). While publications from this centre have been instrumental in developing patient care guidelines, there are disadvantages of single-centre studies that should also be considered (Youssef, Reinhart and Sakr, 2008). For example, in Rio de Janeiro, there are physician-staffed Drowning Resuscitation Centres strategically positioned near beaches that are not found in other parts of the world (Queiroga and Webber, 2014). Hence, drowning victims may have a better chance of survival due to the higher level of medical care available.

What is needed, therefore, are multicentre studies. The establishment of an open-access international registry would be one way to achieve this. Although multicentre studies also have limitations, such as “heterogeneity in clinical practice among centres [that] may be a major confounding factor in interpreting the results” (Youssef, Reinhart and Sakr, 2008, p.120), there are more pros than cons in my view. Such studies could provide the statistical power required to determine things like the number needed to treat; a metric that is relevant to medical interventions, for example. These studies should be overseen by ILS or IDRA.

Establishing a drowning resuscitation registry would improve the quality of research, validate existing treatment guidelines, allow new protocols to be studied prospectively, and may even encourage new researchers to enter the field. If this were to occur, the expertise of epidemiologists in setting up the registry should be enlisted. The goal of such a registry should be to improve patient outcomes, and new guidelines must also be developed that are suitable for LMIC settings.

Establishment of an international drowning research organisation and national aquatic safety agency

It is my intention for IDRA that it can secure funding to employ a general manager (Appendix C). This would reduce the administrative burden on the founding members and allow them to focus on the primary purpose for which the organisation was formed; to foster and grow international networks of drowning prevention researchers. Constraints on volunteers' time is one of the main reasons IDRA has only a modest list of achievements to date; however, IDRA's membership base is testament to the fact they see value in belonging to a professional drowning research network and support group. IDRA is also one of the avenues that I can offer support to new and emerging researchers through, as identified in Chapter 8 as a key personal goal. I have a vested interest, therefore, in ensuring IDRA's success.

The depth of experience and range sub-specialities that exist within IDRA is unrivalled. Despite my bias as a founder, I believe that there is a place for the organisation as a genuinely independent entity run by researchers, for researchers. My role as knowledge translator from academia to practice, as described in Chapter 7, is something that IDRA could coordinate offering the sector, especially given the expertise of members within the organisation who already fulfil this role. I believe that if IDRA can achieve only one or two of its stated goals, then it will have achieved more for collaborative drowning research than any other organisation. How IDRA is made accessible to researchers in LMICs is something that needs to be addressed, however.

PALS (Appendix C) is an example of a PWDP where the societal benefit can be seen in terms of lives saved. The results that have been achieved are extraordinary. The vision of SLSNR in assisting PALS was to do so only if the organisation could become self-sufficient. To their credit, not only have they done this, but they have also started a social enterprise venture called PALS Outdoors to raise funds that will support their lifeguarding operations (PALS Outdoors, 2019). My hope for PALS is that now they have transitioned into a fully operational lifeguard service with only limited reliance on external support, they now look to building resilience within their team and identifying future leaders.

Opportunities may also present to conduct research, which from a lifeguarding perspective is limited in LMICs. The success that they have achieved should be used as a template for other LMICs embarking on setting up a lifeguard service and to those agencies that will be providing training, equipment, and ongoing support to them.

In terms of the assistance that New Zealand can provide to other LMICs, many South Pacific nations do not have established lifeguard services, maritime law enforcement, or search and rescue agencies. A leading cause of drowning in the Pacific Islands is transport accidents at sea, such as the sinking of the MV Princess Ashika and MV Butiraoi ferries (Reid, 2009; Tahana, 2018). Although organisations like Maritime New Zealand through their Pacific Maritime Safety Programme are working to address these issues (Maritime New Zealand, 2019), there is further expertise in drowning prevention that I believe could be contributed by the sector to assist at all levels of The Spectrum of Prevention (Figure 1.4).

Organisations like WSNZ, DPA, SLSNZ, SLSNR, and Coastguard should be enlisted to see what support they can provide in partnership with government agencies such as the Ministry of Foreign Affairs and Trade, Maritime New Zealand, charitable organisations, for example, Rotary, and the private sector (who may be able to assist with the supply of donated or reduced-cost goods and services).

Scientific research in applied lifeguarding practice

All of the studies conducted in applied lifeguard practice (Section 4.4) were baseline studies that concluded more research was needed. There is an opportunity, therefore, for other researchers to undertake this, and already there are examples in the literature where study protocols that I have been part of developing have been replicated (Queiroga et al., 2014). The findings from these studies, in some cases, have only partially been adopted. This provides scope for interventional studies to be performed to either validate or refute them.

For those countries that do not have the funding to implement recommendations requiring technology or equipment, other low-cost, low-tech solutions that may still improve patient outcomes should be considered. Not every recommendation, however, will be transferable or appropriate for use in LMICs.

It would be beneficial if organisations like SLSNZ could establish a research fund and consider following the Australian model of having paid staff coordinating their research programme. In my view, this would ensure research projects are prioritised and resources directed to where the need is greatest.

Despite the enormity of the task, I would encourage the editor of *Drowning* to keep this textbook alive and produce a third edition. Few publications could ever achieve what this textbook has done to provide contemporary, evidence-based information on almost every

aspect of drowning. In my opinion, this book has achieved widespread uptake within the sector. Most, if not all practitioners, either own or have access to a copy. In addition to summarising what evidence exists on various drowning topics, it has also highlighted where more research is needed. In some cases, e.g., supraglottic airway use in drowning (Hood and Webber, 2014) these are topics that MDTs I am part of would like to study.

Lastly, there is the Sentinel System for Response to Drowning (Figure 4.4); my first PWDP produced in 2007 with Billy Doyle. This system has yet to realise its full potential, and I would like to see it adopted by SLSNZ into the training of lifeguards and developed into a multimedia educational tool that can be freely accessed worldwide. Before this occurs, however, more research is needed to ensure that all the recommendations are corroborated by scientific evidence.

Validating Sentinel would also progress another project that I have been working on for over a decade; a textbook on human factors and crisis management in lifeguarding called *In Plain Sight* (Doyle and Webber, n.d.). We believe that this publication will go some way to addressing the lack of educational material currently available on this vital aspect of lifeguarding practice. This is one of several projects I will be embarking on after completing this doctorate (Figure 5.1).

Chapter 10. Conclusions

In this context statement, I have critically reflected on a wide range of public works describing: how they were created; my inspiration and motivation for doing so; positioning of the works alongside the current body of knowledge; translation processes; multidisciplinary approach; communication strategies; personal learning and professional development; (and) future use of the PWDPs. In this chapter, I summarise the main findings and provide advice for other practitioners considering a career in this field.

Key findings

- The experience gained from the surveillance, rescue, treatment, and resuscitation of drowning victims at one of New Zealand's most dangerous surf beaches has been the cornerstone of my ability to produce PWDPs. This, along with the main influencers in my life including family, senior lifeguards and mentors from the PSLSC and other clubs, and friends and co-authors from the international drowning prevention community, have all enabled me to translate work-based research into sector knowledge.
- The assistance provided to PALS in establishing a fully operational lifeguard service that has reduced drowning and help alleviate poverty, creating drowning prevention models that have been endorsed by ILS, ERC, and NZRC, and the foundation of IDRA have been standout achievements in terms of public works.
- There is an ongoing need to review and validate the PWDPs regularly to keep pace with change in the societal, environmental, technological, and volunteer-workforce domains, so their relevance and applicability to the sector are maintained. Linked closely to this is the need for water safety organisations to promote diversity amongst their volunteers, paid staff, and senior leadership teams. Those in governance or high-profile roles, myself included, are accountable for this.
- Lifeguard agencies should recognise the value of work-based research and partner with academic institutions to formulate and prioritise studies that can harness the knowledge that can be garnered from operational activities. This should be supported by a budget, research plan, and a research coordinator to oversee the programme. The opportunity for prospective multicentre studies should also be investigated.
- Autoethnography, as a method of self-reflection, can be used to increase the body of knowledge in lifeguarding, especially in non-technical skills and organisational culture.

One suggested application is in the study of human factors, for which there is a lack of published information and educational resources. Such autoethnographies can evoke an emotional response in others, who in turn, can learn from the shared experience. The introduction of reflective practice should, therefore, be considered.

- Working across academia, and operationally in the frontline, education, managerial, and governance areas of lifeguarding has allowed me to influence and facilitate how evidence is translated into practice. There is a role, therefore, for knowledge brokers at all levels of the sector to assist in bridging the know-do gap and integrating scientific and work-based knowledge into practice. Facilitating access to knowledge brokers and providing them with a base for professional development could be an emerging role for IDRA. Practitioners that are already undertaking this role should be identified and supported accordingly.
- There is no universal evidence evaluation framework or system for grading practice recommendations within lifeguarding. It is recommended that the profession embarks on creating one, therefore, to allow interventions and practices to be validated by an evidence-base to help achieve the primary goal of preventing drowning and providing effective rescue and aftercare for those who require it.
- For a small country, the influence of New Zealand lifeguarding practice on global drowning prevention is remarkable. There are very few international guidelines on beach lifeguarding or drowning resuscitation that have not had input from this country. Along with other New Zealand lifeguards, I have been very proud to bring this perspective to the international stage, knowing that it may help save lives elsewhere. Future envoys who will maintain this level of involvement must now be identified.

To new researchers or those with an interest in this field, my advice would be to align themselves with a water safety organisation, either by joining as a member or in conjunction with an academic institution. This provides a pathway to gain operational experience in the sector they will be working and assists in developing the skills needed to fully understand the research question or hypothesis being tested. I would then ask the host organisation to facilitate an introduction to an experienced researcher who may be able to mentor and possibly include them in a project. This, at an introductory level, could involve undertaking data collection or data entry. Both roles provide a good insight into the research process and

are worthwhile. The next progression would be to co-author a study before taking on a lead-author role. Organisations such as IDRA, national water safety organisations, and universities can assist with mentorship, introductions, and connecting researchers that want to conduct multicentre studies or trials.

Attending the next WCDP or national drowning, rescue or resuscitation conference provides an excellent opportunity to meet with industry experts and can foster interest in a topic. This is particularly useful if the prospective researcher has not decided on their area of special interest. I would recommend attending at least one of these events, therefore, to form professional contacts and as a potential source of inspiration. While this will incur a financial cost, the ability to hear a variety of presentations and interact with the speakers is invaluable in terms of meeting like-minded individuals, obtaining a perspective on issues from other parts of the world, and even being invited to join special-interest groups. Once involved in the production of public works, I would urge new researchers to always keep the end-user in mind, consider their utility in LMICs, and make the works open-access wherever possible. They should also remember the reason why most drowning prevention practitioners were motivated to enter the field in the first place; to save lives.

To conclude, we must never lose sight of the fact that the prevention of drowning will always be a better cure than the rescue or resuscitation from it. With over 320,000 lives lost annually, there is still much work to be done…

Appendices

Appendix A: Examples of public works in developing drowning prevention models and reaction mnemonics

Appendix B: Examples of public works in the revision of drowning data collection and patient care guidelines

Appendix C: Examples of public works in establishing an international drowning research organisation and national aquatic safety agency

Appendix D: Examples of public works in applied lifeguarding practice

Appendix E: Sentinel Full System for Response to Drowning

Appendix F: Impact assessment of studies by SLSNZ medical director

Appendix G: Water Safety New Zealand member organisations

Appendix A: Examples of public works in developing drowning prevention models and reaction mnemonics

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Commentary and Concepts

Creating a drowning chain of survival☆

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ABSTRACT

All nations would benefit from a simple, clear Drowning Chain of Survival. In high income nations this tool will refine prevention and the call for action. In low and middle income nations this tool is a guide for policy making, resource allocation and priority setting in drowning prevention. A best evidence approach was utilized to create a universal *Drowning Chain of Survival*. Education on how to prevent drowning and to how react when a drowning incident occurs has not always been guided by good levels of evidence, or high levels of specialized training in drowning process recognition and management. The *Drowning Chain of Survival* refers to a series of steps that when enacted, attempts to reduce mortality associated with drowning and attempted aquatic rescue. The term "chain of survival" has provided a useful metaphor for the elements of the emergency cardiac care system for sudden cardiac arrest, however interventions and patient management in drowning involves principles and actions that are specific to these situations. The result is a unique and universal *Drowning Chain of Survival* comprised of five links guiding the important life-saving steps for lay and professional rescuers. This may significantly improve chances of prevention, survival and recovery from drowning. The steps of the chain are: Prevent drowning, Recognize distress, Provide flotation, Remove from water, and Provide care as needed.

1. Introduction

The term "Chain of Survival" has provided a useful metaphor for the elements of the emergency cardiac care system for sudden cardiac arrest, however interventions in drowning involves principles and actions that are specific to these situations. A unique and universal *Drowning Chain of Survival* can guide the important life-saving steps for lay and professionals rescuers. This may significantly improve chances of prevention, survival and recovery for people in potential danger in water.

Prevention is the most important contributor to reduce drowning mortality and morbidity. In low and medium income countries (LMIC) where more than 90% of the global drowning occurs, guidance to accelerate culturally appropriate prevention, rescue and resuscitation strategies are most urgently needed.[1] High income countries (HIC) have seen dramatic reductions in drowning mortality as a result of reduced risks and effective strategic interventions. Further mortality reduction can be facilitated with the introduction of effective approaches to prevention, rescue and resuscitation in LMIC settings.[2]

When preventative measures fail, responders need to be able to perform the necessary steps to interrupt the drowning process. The first challenge is to recognize someone in distress and the need to activate rescue and emergency medical services (EMS) appropriately when possible. It is critical that rescuers take precautions not to become another victim by engaging in dangerous behaviors.[3]

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2014.05.034.

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Early rescue may prevent the initial and subsequent water aspiration, respiratory distress and medical complications.

The entire drowning process, from submersion/immersion to cardiac arrest usually occurs in seconds to a few minutes.[4] If the person is rescued alive, the clinical picture is determined predominantly by the amount of water that has been aspirated. In some cases, even an early and effective rescue will not prevent the medical consequences and in these cases basic and advanced life support interventions may be required.[5]

An effective educational strategy on drowning can assist both LMIC and HIC responders to recall important preventative measures as well as critical response steps. One such strategy has involved promoting icons in the form of a *Drowning Chain of Survival*.[6,7]

The purpose of this concept is to describe the development of a new and universal *Drowning Chain of Survival* for the prevention and effective response to drowning incidents based on conceptual, practical, and educational value.

1.1. Reviewing concepts and models

In 2013, a group of experts reviewed the need to update the existing *Drowning Chain of Survival* by examining all elements of current and similar models. The four major elements of the European Resuscitation Council (ERC) and five major elements of the American Heart Association (AHA) chains of survival were evaluated from an applicability to drowning perspective.[8]

The first[6] *Drowning Chain of Survival* developed in 2002 resulted from a realization that drowning prevention and first aid education had several unique characteristics not captured in the emergency cardiovascular care (ECC) chains of survival. Basic and advanced life support in the aquatic environment requires specific skills and knowledge that were not taught in regular first aid and cardiopulmonary resuscitation (CPR) education.[9] The result was an original *Drowning Chain* composed of icons that formed 6 links.[6]

The 2012 "*Drowning Response*" adopted by the American Red Cross (ARC) was reviewed.[10] The ARC Drowning Response chain did not include prevention; instead it addressed the key evidence-based effective drowning prevention strategies by developing a specific Circle of Prevention.[10]

The "*Call to Action*" system used by Surf Life Saving New Zealand was also reviewed. It includes a "provide flotation" link as a priority intervention, emphasizes the importance of rescuer safety, and omits links that duplicate information already contained in the ECC Chain of Survival.[8,11]

A Delphi-like process among experts was performed by email previously to the workshop at the World Conference on Drowning Prevention in 2013 (WCDP-2013) where conceptual, practical, and educational values were examined supported by medical, pedagogical and lifeguarding science. A facilitated discussion identified ways to evaluate whether the proposed model would meet the needs of all layers of prevention and response, as well complying with International Organization for Standardization (ISO) requirements. In closing the session at the WCDP-2013 a final summary including all the relevant ideas, identifying key areas of agreement and unresolved issues were presented. After the workshop, input from the participants continued to be collated and refined.

2. Result

A new concept of a *Universal Drowning Chain of Survival* containing 5 links (Fig. 1) is described.

2.1. "PREVENT DROWNING – be safe in and around the water"[12]

It has been estimated that most drownings are preventable.[12] The ability to avoid a drowning contrasts with the high rates of poor outcomes following these type of incidents. Drowning requires multiple layers of protection. To be effective, drowning prevention must be used by individuals near, on or around the water, and those who supervise or care for others in water settings.

2.1.1. Major advice actions

- Stay within arm's reach of children when in or near the water
- Swim in water-safe areas where there lifeguards
- Fence pools, spas and other aquatic with 4-sided or any fencing
- Always wear a lifejacket when using watercraft (eg. Boat, kayak etc.)
- Learn how to swim and water-safety survival skills.

2.2. "RECOGNIZE DISTRESS – call for help"

The first challenge is to recognize a person in distress in the water and know how to act safely, and to activate the lifeguard, rescue and emergency medical services (EMS) if possible and available. *Frank Pia* contradicted the prevailing notions that most victims struggle at the water's surface, call or wave for help, and actively attack rescuers. He showed that a person struggling and about to drown cannot usually call for help.[4]

In 1995, Langendorfer and Bruya identified key developmental components of aquatic readiness and water competency and a *Drowning Risk Assessment* was created.[13] Identified recognizable elements of a person at high risk of drowning include: Near vertical body position, ineffective downward arm movements, ineffective pedaling or kicking leg actions, and little or no forward progress in water.[14] Sending someone to call for help upon recognizing a person in water distress is a key element in the drowning response chain. Delays in activating EMS/rescue services increases the risk of fatal drowning.[3]

2.2.1. Major advice actions

1. Recognize early drowning victim's distress signs. Victims may not wave or call for help
2. Tell someone to call for help while staying on-scene to provide assistance
3. Watch where the victim is in the water, or ask a bystander to keep constant watch.

2.3. "PROVIDE FLOTATION – to prevent submersion"

After recognizing a victim is in distress and asking someone to call for help, the next priority is to interrupt the drowning process by providing flotation to the victim. Providing flotation is a strategy not widely employed despite buying valuable time for emergency services to arrive, or for those on-scenes to plan rescue efforts. Most rescuers tend to focus on the *strategic goal* of getting the victim out of the water even if there is a high threat to life/rescuer safety.[15] Devices such as ring-buoys (life-buoys) are purpose-designed to provide flotation. However, they are not always available at the scene of a drowning incident. Therefore, improvised buoyancy aids such as empty plastic bottles/containers, body-boards, surfboards, driftwood, ice-chests, etc. should be used. It is critical that lay persons take precautions not to become another victim by engaging in inappropriate/dangerous behaviors.[3] Given the number of bystanders who drown while attempting to rescue others, reaching out with, throwing, or dropping the buoyancy aid without entering the water is the safest course of action.[16]

Fig. 1. Pictogram of the new Drowning Chain of Survival.

2.3.1. Major advice actions

While helping others:

1. Stay out of the water to reduce rescuer risk.
2. Throw something that floats to the victim

To help yourself:

1. If you are in difficulty, do not panic; stay with any flotation you may have
2. Signal for help as soon as and if possible, and float.

2.4. "REMOVE FROM WATER – only if safe to do so"

Removing the victim from the water is essential in order to provide a definitive end to the drowning process. Several strategies for removal can be used: Assist the victim to get out of the water by giving directions, i.e. pointing out to the closest and safest place to get out. Attempt to remove the victim without fully entering the water by utilizing rescue techniques such as, reaching, throwing and wading out with equipment; If all else fails, the lay rescuer may then consider entering the water. The entry of an untrained person into the water to rescue someone is extremely dangerous and is not recommended.[3,16] In order to mitigate the risk during a rescuer ***must*** bring a source of flotation as to assist the victim.

2.4.1. Major advice actions

1. Assist the victim on how to self-rescue by giving them directions for getting out of the water
2. Try to remove the victim without entering the water
3. Only if safe to do so, rescue the victim using any flotation available.

2.5. "PROVIDE CARE AS NEEDED – seek medical attention"

Basic life support for drowning patients is unique due to the dangerous environment which may pose some difficulties in providing care before, during or after the rescue process. The need for, and initiation of basic life support may occur while the victim is still in water if the rescuer is trained and can provide in-water resuscitation safely.[5] If not interrupted, the drowning process leads to apnea followed by cardiac arrest within minutes. Any attempt to immobilize the spine will impede rescue, and more importantly delay resuscitation. Therefore, attempts to immobilize the spine should only be made where there is strong evidence of cervical spine injury.[17] Transporting and positioning drowning victims also requires specialized adaptations.[18]

CPR is needed when the heart stops following a period of apnea.[5] It is imperative that CPR follows the traditional Airway–Breathing–Circulation (ABC) approach in this setting of hypoxic induced cardiac arrest.[19] Initial ventilations may be ineffective in drowning due to the presence of water in the upper airway.[5] Airway management is always challenging due to vomiting/regurgitation and the fluid that is commonly present in the upper airway. Also unique to drowning is that the most common rhythm in cardiac arrest following drowning is asystole.

As soon the victim is removed from the water, rescuers must recognize the drowning severity especially if there is a life-threatening situation so immediate care can be provided.[20] As the majority of people with mild distress may not actually aspirate water it is important to educate responders when to call the ambulance or seek medical assistance/hospital care.[20]

2.5.1. Major advice actions

1. If not breathing, start CPR (ventilations and compressions) immediately.[20]
2. Consider the use of oxygen and an automated external defibrillator as soon as possible if available.
3. If breathing, stay with victim until help arrives.[20]
4. Seek medical aid/hospital if any symptoms are present, and for all victims who require resuscitation.[20]

Summary

Education on how to prevent and to how act when a drowning incident occurs has not been guided by high-level evidence. The concept of having a suggested course of action for drowning is not new, but has never had worldwide acceptance, and never been adopted as a standard of care, instruction or communication.

During the process of establishing a new and universal *Drowning Chain of Survival* the authors faced many challenges. The major issues were: the diversity of how drowning is perceived around the world, the heterogeneity of knowledge, existing drowning response models, how best to reconfigure the chain and the evaluation of compliance with international signage standards so "one shoe could fit all". As work on the model progressed, it became evident that the simpler the message the more acceptable and widely used it would be for different scenarios and levels of rescuer-experience.

The resultant new *Drowning Chain of Survival* does not prescribe specific advice but rather gives general guidance to all involved in preventing or taking action in a drowning incident.

Although a consensus on a new *Drowning Chain of Survival* has resulted from this process, the model still needs to be accepted, used, and validity-tested in different aquatic scenarios and with groups of professionals to lay persons, in HIC and LMIC settings, that may be called upon to respond in an aquatic emergency.

Conflict of interest statement

None declared.

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The *4Rs of Aquatic Rescue*: educating the public about safety and risks of bystander rescue

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From 1980 to 2014, 87 persons drowned in New Zealand while attempting to rescue others; all incidents occurred in open water and most (80%) fatalities were male. While bystander rescue has been promoted as a way of preventing drowning, little is known about the knowledge base that informs potential rescuers. This study utilized a family water safety programme to promote a resource entitled the *4Rs of Aquatic Rescue*. Participants ($n = 174$) completed a pre-intervention survey and were then provided with information and access to electronic resources on safe bystander rescue techniques. Most respondents (71%) had never been taught rescue techniques, and males were more confident of their rescue ability. Upon completion of the programme, significant differences were evident in respondents' understanding of rescue safety, but this did not translate to greater confidence or disposition towards performing a rescue. Ways of promoting bystander safety around water are discussed and recommendations for future studies are made.

Keywords: rescuer drowning; aquatic-victim-instead-of-rescuer (AVIR) syndrome; multiple drowning incidents; water safety education; rescue competency; drowning prevention

Introduction

A recent comparative analysis of drowning incidents in 60 countries reported that falling into open water accounted for almost half (43%) of fatalities in New Zealand, and one-third (33%) of fatalities in Australia (Lin, Wang, Lu, & Kawach, 2014). While most open water drowning events are preventable, many require the intervention of others and, in some circumstances, the consequences of such intervention can itself result in loss of human life (Moran & Stanley, 2013). From 1980 to 2014, 87 persons drowned in New Zealand while attempting to rescue others (Water Safety New Zealand [WSNZ], 2014). Of these, most (80%) were male; Maori (33%) and Pasifika (12%) people were over-represented. All rescue fatalities occurred in open waters with beaches (54%) and rivers (22%) being the most frequent sites of drowning. Rescuer fatalities are often dramatically reported by the media, especially where the rescue of children or members of a family are concerned (for example, *Bay of Plenty Times*, 2014; *Sunday Star Times*, 2014). In spite of a high media and public profile, until recently, research studies on the phenomenon have been lacking.

One study found that bystanders' actions can make a critical difference in preventing loss of life, but rescuer safety is a foremost consideration (Venema, Groothoff, & Bierens, 2010). A recent Queensland study reported that one-quarter (24%) of survey respondents had undertaken a rescue at some time of their life, 42% of victims were not known to the rescuer, and the mean age of victims was 15 years. (Franklin, King, & Leggat, 2015). Other studies have found that rescuer drowning incidents often involve more than one victim (Franklin & Pearn, 2010; Turgurt & Turgut, 2012). The loss of rescuer life in drowning emergencies has been described by Franklin and Pearn (2011) as the aquatic-victim-instead-of-rescuer (AVIR) syndrome, and in many developed countries, it is a persistent cause of drowning mortality. Recently, some attempt has been made to analyse the underlying motivations of the rescuer who drowns (Pearn & Franklin, 2012), but little is known about what skills and knowledge the rescuer possessed that may have prevented their drowning. One study has found that more than half of fit adults tested in a simulated drowning incident on dry land could not throw a rope accurately (Pearn & Franklin, 2009).

New Zealand studies have identified a lack of lifesaving training. A nationwide water safety survey of New Zealand youth found that one-third (35%) considered that they had no rescue ability, and more than half (59%) expressed doubts about their ability to perform a deep-water rescue (Moran, 2008a). A lack of rescue ability has also been reported among 21-year-old Dunedin young adults, most of whom (52%) had not received any lifesaving training (Gulliver & Begg, 2005). In a study of parents/caregivers ($N = 769$) in charge of children under

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10 years of age at 18 New Zealand beaches during the summer of 2007, more than three-quarters (76%) of parents surveyed had not received any rescue/lifesaving training (Moran, 2009). Importantly, male beachgoers were more confident of their ability to rescue their child even though they reported no more lifesaving training than the females that took part in the study. Festivalgoers ($N = 415$) attending a cultural event in Auckland, took part in a water safety survey that included information on their readiness to respond in a drowning emergency (Moran & Stanley, 2013). Many indicated they would jump in and rescue a victim (47%), while less than one-third (30%) would get flotation to the victim. Most (62%) estimated that they could only swim less than 100 m; 85% reported having swum that distance in a swimming pool rather than in open water where most rescues take place.

While the risk factors associated with bystander rescue are now well known and reported, it is unlikely that altruistically motivated rescuers will resist impulsive attempts to rescue a drowning person (Pearn & Franklin, 2012). Bystanders are recognized as a potentially valuable contributor to drowning prevention in the World Health Organisation (WHO) Global Report on Drowning that identifies 10 key actions to prevent drowning – the fourth of which is to train bystanders in safe rescue and resuscitation (WHO, 2014). Educating people about how to respond without endangering their own life has become the focus of attention, and the promotion of non-contact rescue techniques in lifesaving literature is now the norm (for example, Royal Life Saving Australia [RLSSA], 2006, 2012). In New Zealand, rescue skills have traditionally been taught within the swimming and lifesaving component of the physical education syllabus (Department of Education, 1987), however, evidence of how well informed or equipped members of the public are to engage in rescue activity is currently lacking.

It is the purpose of this study to evaluate a new resource entitled the *4Rs of Aquatic Rescue* by measuring the uptake of rescue information and emergency procedures among members of the public exposed to it. In addition, it will ascertain the prior knowledge and understanding of bystander rescue, the formal training in rescue skills and procedures, and the levels of confidence of participants to engage in emergency rescue activity.

Method

Programme development

The *4Rs of Aquatic Rescue* resource was developed in response to unusually high rescuer drowning fatalities during the previous summer season (November 2014–March 2015) and raised public concern about the dramatic and tragic loss of life. The development of a mnemonic entitled the *4Rs: Recognise, Respond, Rescue, Revive*, and the advice proffered in conjunction within these steps of bystander rescue were based on longstanding lifesaving advice, such as the Shout-Reach-Throw-Row-Go-Tow (Royal Life Saving Society Canada, 1972), and Check-Talk-Reach-Throw-Wade-Row (RLSSA, 2012). The sequencing of steps in the 4Rs was predicated on a recently proposed *Drowning Chain of Survival* designed to inform lay and professional rescuers (Szpilman et al., 2014).

The pictogram (Figure 1) illustrates critical components of the survival chain upon which the 4Rs have been developed. They specifically include the recognition of distress (the first R – Recognise), the provision of flotation in the immediate response phase (the second R – Respond), the removal from water by rescue (the third R – Rescue) and the final phase of provision of post-rescue care (the fourth R – Revive). Each of the critical phases was populated with simple advice as to what to do based on safety of self and others (including the victim).

Resources developed to promote the 4Rs included: 5000 pamphlets for public distribution (WaterSafe Auckland Inc. [WAI], 2015a), a website page with downloadable resources and a video link to a practical demonstration on how to apply the 4Rs (WAI, 2015b). This information was also available via social media (Facebook and YouTube) and promoted in newspaper releases (for example, *New Zealand Herald*, 2013, 2014) prior to the commencement of the study. Participants were given copy of the pamphlet and the video link to the practical demonstration after they had completed the initial survey.

Study design

The study design chosen for this study was a repeated measures (test–retest) experimental design. The setting

Figure 1. Pictogram of the new Drowning Chain of Survival (Szpilman et al., 2014).

for the study was 20 swimming pools in metropolitan Auckland, and data gathering took place over the summer months (October–January 2016) during free water safety lessons aimed at parents ($n = 467$) and their children aged 9 months–8 years ($n = 790$). Entitled Whanau Nui (Maori term meaning Family Way), the programme was developed and organized by WaterSafe Auckland Inc. for parents/caregivers and their children. The emphasis in the intensive five 30-minute sessions was teaching water safety and water competence rather than the traditional 'Learn-to-swim' focus. Topics covered in the programme include lifejacket use, flotation, safe entries and exits, supervision and safe bystander rescue. The inclusion of the latter component provided the opportunity to assess the value of the *4Rs of Aquatic Rescue* promotion and is the focus of the present study.

Participants and procedures

Participants were a group of parents/caregivers ($n = 467$) whose children were enrolled in water safety lessons at eight Auckland swim schools. Parents/caregivers were given copy of the new resources and invited to take part in a pre- and post-programme survey that sought information on their level of understanding and perceptions of rescue competency. The self-completed written questionnaire was given out prior to the distribution of the *4Rs of Aquatic Rescue* resources and the commencement of the in-water sessions with their children. Participants were asked to complete a follow-up survey upon completion of the water safety programme.

Research instruments

The self-completed questionnaires consisted of 18 questions and were designed to be completed in 10–15 minutes. The questionnaires sought information on sociodemographic characteristics (including age, sex, length of residence and ethnicity). Self-estimates of swimming competency included the use of a 4-point scale of *very good*, *good*, *fair* and *poor*, an estimate of how far they could swim nonstop, and whether they had swum the estimated distance in open water. They also included questions on any previous lifesaving (not lifeguard) and cardiopulmonary resuscitation (CPR) instruction, and any personal recall/experience of rescue from drowning. Using a 0–100 scale, participants were asked to subjectively estimate their ability to perform a rescue, their willingness to perform a rescue on someone they knew, and on a stranger. Participants were also asked to express their levels of confidence in responding to an emergency incident where risk of drowning was present using a 4-point scale from *extremely confident* to *extremely anxious*.

Two questions sought information on participant's knowledge and understanding of rescue techniques and procedures. The first asked for true/false responses to series of eight statements about rescue procedures (for example, *If you think someone is in trouble in the water shout 'Are you okay?'*). The second required participants to correctly order the steps recommended in performing a rescue (for example, first R – *Recognise*) and linking the step to the correct safety message (for example, *Look for signs of distress*). The only difference in the pre- and post-intervention surveys was the final question in each survey. The final question in pre-intervention survey sought information on respondents' perceptions of risk of drowning using a 5-point Likert type scale from *strongly agree* to *strongly disagree* based on previous water safety surveys of beachgoers (McCool, Moran, Ameratunga, & Robinson, 2008) and rock-based fishers (Moran, 2008b). The final question in the post-intervention survey was similarly structured, but focussed specifically on attitudes to bystander rescue.

Data analysis

All pre- and post-intervention data were entered into SPSS (Version 23, Armonk, NY, USA) for statistical analysis. Frequency tables using numbers and percentages were generated to report on respondent's self-estimated swimming and rescue competencies, previous training and perceptions of rescue protocols and practice. Because the pre- and post-interventions surveys were not matched, the data were treated as two independent samples. Measures of central tendency used to measure continuous data (such as the 0–100 scales) included means, medians and standard deviation with independent samples *T*-tests to measure levels of significance between pre- and post-intervention responses. For binary data, chi-square tests were used to ascertain the associations among dependent variables (such as rescue knowledge and self-reported competencies) and independent variables (such as sex, age and ethnicity).

Results

Of the 467 adults enrolled in a parent and child water safety programme conducted in the summer of 2015–2016, 174 adults agreed to take part in the pre-entry survey, a response rate of 37%. Of these, most were female (77%) and aged between 30 and 44 years (67%). One-third of the respondents (33%) had lived in New Zealand for less than 10 years. In terms of ethnicity, the sample approximated proportions reported in the 2013 Census data (Auckland Council, 2014) for the Auckland region with 50% of the sample self-identifying as European, 18% as Maori, 12% Pacific Island people, 17% Asian and 2% as being from 'other' ethnic groups. When asked about their swimming competency, most reported that they could swim (87%), and of these, most considered themselves to be *good/very good* swimmers (64%);

although when asked how far they could swim, only half (50%) thought they could up to 25 m. Less than half (49%) reported having swum that distance in open water, and of these, 40% had done so in the previous year.

Pre-intervention knowledge of bystander rescue

Table 1 shows responses to questions on any rescue and CPR instruction they had received prior to the onset of the water safety programme. Most respondents (71%) had never been taught rescue techniques. Of those who had received instruction, schools were the most frequent site of learning (47%) and most (78%) had received instruction more than 10 years ago. When analysed by gender or age, no significant differences were evident in prior rescue training. Significant differences were evident in the extent of lifesaving instruction when analysed by ethnicity and length of residency. Fewer Asian (9%) than non-Asian respondents (35%) had received rescue training (χ^2 = 16.482 (1), p = <0.001) and fewer short-term residents (<10 years, 17%) than long-term residents (>10 years, 36%) reported having had rescue instruction (χ^2 = 11.672 (1), p = 0.001).

Table 1. Lifesaving and CPR instruction and confidence prior to programme commencement (N = 174).

		N	%
Lifesaving instruction?	Yes	50	29%
	No	124	71%
If yes, (n = 50) when?	0 4 years	4	8%
	5 9 years	7	14%
	10 years+	39	78%
Where?	School	24	47%
	Club	18	35%
	Family/friends	4	8%
	Self-taught	5	10%
How do you feel about rescuing someone in open water?	Very confident	8	5%
	Confident	53	31%
	Anxious	77	44%
	Very anxious	36	21%
CPR instruction?	Yes	119	68%
	No	55	32%
If yes, (n = 119) where?	School	9	8%
	Club	13	11%
	Family/friends	11	9%
	First aid course	86	72%
If yes, (n = 119) when?	In the last year	32	27%
	In the last 5 years	45	38%
	In the last 10 years	19	16%
	>10 years	24	20%
	Total	174	100%

When asked what would be their immediate response to seeing someone in difficulty in the water, one-quarter (26%) gave the correct response of getting flotation to them, but more than one-quarter (29%) responded that they would jump in and rescue the victim. When asked about their experience of rescue, 36% knew someone who had been rescued, one-third (33%) had seen someone being rescued and a small proportion had rescued someone (6%) or had been rescued themselves (3%). One-third of respondents (35%) were confident of their ability to safely rescue someone in open water. Most (68%) had received CPR training, and two-thirds (65%) had received this training in the past five years.

When analysed by sex, significantly more males (68%) than females (25%) had confidence in their ability to rescue someone in trouble (χ^2 = 48.580 (3), p = <0.001). Females were three times more likely than males to be 'very anxious' about their ability to perform a rescue (females 26%, males 8%). No significant differences were found when rescue confidence and CPR training were analysed by age, but when analysed by ethnicity, significantly fewer Asian (17%) than non-Asian respondents (40%) expressed confidence in their ability to perform a rescue (χ^2 = 19.641 (3), p = <0.001). Significantly fewer Asian (55%) than non-Asian respondents (74%) had received CPR instruction (χ^2 = 8.242 (3), p = 0.004). When analysed by length of residency (<10 years, >10 years), significantly more respondents of recent residency (73%) than long-term residents (61%) were *anxious/very anxious* about their rescue competence (χ^2 = 14.196 (3), p = 0.003).

When asked to indicate on a percentage scale their ability to rescue someone in trouble in open water (prior to receiving instruction on safe rescue techniques and procedures), the mean score was 37%. Respondents were also asked to indicate their willingness to rescue someone they knew and someone they did not know using a percentage scale. In the pre-intervention survey, a mean score of 73% was reported for participant's willingness to rescue someone they knew, but proportionally, fewer respondents indicated a willingness to rescue someone they did not know (62%). No significant differences were found in willingness to rescue someone they knew or rescue a stranger when analysed by sex, age, ethnicity or length of residency.

Post-intervention changes in bystander rescue knowledge

Upon completion of the five day in-water programme, parents/caregivers repeated the survey to determine what effect the intervention had on their knowledge of, and attitudes towards bystander rescue. No significant differences were found in the socio-demographic data of respondents who took part in the initial (n = 174) and the

Table 2. Correct responses to rescue safety knowledge pre-intervention ($N = 174$) and post-intervention ($N = 143$).

	Answer (✓/x)	Pre-intervention *n*/%	Post-intervention *n*/%	χ^2	*p*
If you think someone is in trouble in the water, shout 'Are you okay?'	✓	113 65%	111 78%	8.962	0.011*
Waving arms and shouting for help are normal signs of someone drowning	×	40 23%	48 34%	5.570	0.062
The victim's safety is the key concern in attempting any water rescue	×	54 31%	74 52%	14.583	.001*
Seconds count, swim towards a drowning person as soon as possible	×	23 13%	48 34%	19.069	<0.001*
Always take flotation if you have to go in the water to perform a rescue	✓	122 70%	125 88%	17.610	<0.001*
The correct compression to ventilation ratio for CPR is 30:2	✓	65 37%	83 59%	16.558	<0.001*
If a person is feeling okay after being rescued they do not need medical help	×	95 55%	121 85%	37.257	<0.001*
If conscious, get the rescued person mobile as soon as possible to warm them up	×	38 22%	61 43%	16.336	<0.001*

*Statistically significant difference.

post-intervention survey ($n = 142$). Table 2 shows the changes in the proportion of correct responses to eight statements related to bystander rescue knowledge. Significant differences in the number of correct responses were evident in all but one of the statements post-intervention, that one being the statement regarding the waving of arms in a drowning victim. Most respondents incorrectly thought that the waving of arms was a characteristic of a drowning person both pre- (incorrect response 72%) and post-intervention (incorrect response 60%).

No significant differences were evident when bystander rescue knowledge was analysed by gender or age group in either the pre-intervention or post-intervention surveys. No significant differences were evident when rescue knowledge was analysed in the post-intervention survey by ethnicity and length of residency, except in the response to the statement on victim safety being the primary concern. Significantly fewer Asian (24%) than non-Asian (60%) participants correctly responded to the statement concerning the primacy of their safety in a rescue situation ($\chi^2 = 14.552$ (2), $p = 0.001$), and fewer recent residents (41%) than long-term residents (59%) also thought the victim's safety of greater concern than their own ($\chi^2 = 8.869$ (2), $p = 0.038$).

Table 3 shows the pre- and post-intervention differences in recall of the correct sequence of the 4Rs order and their related key point. Significant improvements are evident in each of the tasks with most respondents able to recall the correct order of events (range 80%–86%), and most were able to relate the correct key point to each phase of the rescue (range 57%–69%).

No significant differences were found in the correct recall of the phases and their related key point when analysed by gender, age group, ethnicity or length of residency.

Post-intervention perceptions of bystander rescue

Table 4 shows participants' beliefs about their capacity to safely rescue someone in trouble in the water at the end of a water safety programme that provided information about safe bystander rescue techniques. One-half of respondents (51%) considered they had sufficient knowledge but many (56%) thought that they would be too afraid to help irrespective of who was in the water. Only one-quarter (25%) considered their swimming ability enough to prevent their drowning, and most (60%) were still unsure of any protective effect of their swimming ability in a rescue situation. In addition, most thought that others with better

Table 3. Correct responses to order of 4Rs and related response pre-intervention ($N = 174$) and post-intervention ($N = 143$).

	Pre-intervention *n*/%	Post-intervention *n*/%	χ^2	*p*
Recognise	69 40%	119 84%	63.295	<0.001*
Look for signs of distress	48 28%	97 69%	52.604	<0.001*
Respond	61 35%	113 80%	62.651	<0.001*
Provide flotation	27 16%	91 64%	79.565	<0.001*
Rescue	62 36%	117 82%	69.659	<0.001*
Stay clear of the person	15 9%	91 57%	90.074	<0.001*
Revive	73 42%	122 86%	64.174	<0.001*
Wait for help to arrive	26 15%	91 64%	82.760	<0.001*

*Statistically significant difference.

Table 4. Perceptions of rescue competency post-intervention ($N = 143$).

	Agree/strongly agree	Disagree/strongly disagree	Unsure/nil response
I have sufficient rescue knowledge to save someone else	84 59%	54 38%	5 4%
Better to risk your own life than watch someone drown	33 23%	105 73%	5 4%
My lack of swimming ability means I would probably drown trying to rescue someone	72 50%	66 46%	5 4%
I would ask others to rescue someone and tell them how to do it safely	68 48%	70 49%	5 4%
I would be too afraid to help irrespective of who it was in the water	22 15%	116 81%	5 4%
I would only be able to respond if it were family in trouble	34 24%	104 73%	5 4%
I would jump in to help in a pool but not in open water	57 40%	81 57%	5 4%
I would jump in to help only if I was supervising the person	27 19%	111 78%	5 4%
It is not my responsibility to rescue other people	16 11%	122 85%	5 4%
Better swimmers than me should do the rescue	96 67%	42 29%	5 4%

swimming ability should perform a rescue (61%), and one-half (52%) thought rescue was the responsibility of others.

When post-intervention rescue attitudes were analysed by gender, significant differences were found in responses to three of the eight statements. Significantly more males than females (males 74%, females 53%) considered they had sufficient rescue knowledge ($\chi^2 = 6.860$ (2), $p = 0.032$), more males (males 77%, females 49%) were willing to perform rescue in open water ($\chi^2 = 10.761$ (2), $p = 0.005$) and more males (males 49%, females 22%) disagreed that better swimmers should perform a rescue ($\chi^2 = 10.758$ (2), $p = 0.005$).

No significant differences were evident in post-intervention perceptions of rescue when analysed by age group or length of residency. When analysed by ethnicity, significantly fewer Asian (35%) than non-Asian respondents (65%) considered they had sufficient rescue knowledge ($\chi^2 = 9.336$ (2), $p = 0.009$), and significantly more (Asian 79%, non-Asian 43%) thought their lack of swimming ability would result in their drowning ($\chi^2 = 12.649$ (2), $p = 0.002$). In addition, more Asian (79%) than non-Asian (43%) thought that they would be too afraid to rescue someone irrespective of who it was in trouble ($\chi^2 = 6.883$ (2), $p = 0.032$).

Changes in self-estimated rescue ability, willingness to perform a rescue

T-test analysis of self-estimated percentage rating of rescue ability and willingness to perform a rescue on a known and unknown victim suggest that the acquisition of knowledge on how to safely perform a rescue did not significantly change confidence in would-be rescuers' ability or their disposition towards rescuing known and unknown victims (Table 5).

When analysed by gender, significant differences ($t = 3.399$, $p = 0.001$) were evident in the post-intervention mean scores of self-estimated rescue ability, with males estimating greater rescue ability (males mean estimate 53%, females mean estimate 37%), but no gender differences were evident on willingness to rescue someone known or unknown. When analysed by ethnicity, significant differences ($t = 2.785$, $p = 0.006$) were evident in the mean scores of Asian (mean estimate 29%) and non-Asian respondents (mean estimate 44%), but no differences were evident on willingness to rescue someone known or unknown. No differences in self-estimated rescue ability post-intervention were evident when mean scores were analysed by age group or length of residency.

Table 5. Changes in mean percentage ratings of self-estimated rescue ability, willingness to perform a rescue pre-intervention ($N = 174$) and post-intervention ($N = 143$).

		m	Standard deviation (SD)	Median	Mean diff.	*t*	*p*
Rescue ability	Pre-intervention	37.2%	26.771	30	−3.371	−1.106	0.269
	Post-intervention	40.6%	27.056	45			
Willingness to rescue someone you know	Pre-intervention	73.1%	30.701	90	−2.188	−0.669	0.504
	Post-intervention	75.2%	26.554	85			
Willingness to rescue someone you do not know	Pre-intervention	62.3%	31.754	70	−1.260	−0.351	0.726
	Post-intervention	63.6%	31.744	70			

Discussion

This study examined the knowledge and perceptions of bystander rescue among participants in a family water safety programme that included safe rescue information called the *4Rs of Aquatic Rescue* as part of its content. As well as providing evaluation of the safe rescue programme, the results provide new information on what members of the public know, and how they feel about helping others in a drowning-related emergency.

Profile of a bystander rescuer

Results from the pre-intervention phase of this study suggest that many people are not well prepared for an open water rescue, irrespective of how rare or commonplace they might be. When asked about their swimming competency, most participants (87%) reported that they could swim and, of these, two-thirds (64%) considered themselves to be good swimmers, yet one-half (50%) could only swim up to 2 m – a capacity unlikely to offer much protection from the risk of drowning as has been previously reported (Stanley & Moran, in press), and even less likely given the demands of an open water rescue emergency. To compound the risk, half (51%) of the respondents had not swum their estimated swimming distance in open water and, of these, less than half (40%) had done that in the previous year. On the basis of this self-reported swimming competence, it would appear that many would-be rescuers do not possess the necessary swimming base to safely perform an open water rescue, and this alone may explain why some rescuers drown.

In terms of previous lifesaving training, most participants (71%) had not received any formal instruction and, of those who had, more than three-quarters (78%) had received that instruction more than a decade ago. It is not surprising therefore that most (65%) felt anxious about rescuing someone in trouble in the water, with females and Asian respondents especially more likely to be anxious about their rescue capability. A similar lack of bystander emergency skills (such as CPR) among new residents has been previously reported in adults (Moran & Willcox, 2013), Asian youth (Moran, 2006) and Pasifika youth (Moran, 2007). Given the lack of rescuer safety education via schooling and public education in general and for some population groups with no formal water safety education (such as new settlers and Asian peoples) in particular, targeted interventions in schools and public water safety campaigns are recommended.

When asked about their rescue knowledge, levels of understanding varied considerably (see Table 3). While two-thirds of the respondents correctly agreed for the need to shout 'Are you okay?' to the person in the water, less than a quarter (23%) correctly disagreed that waving arms and shouting for help were normal signs of someone drowning. Alarmingly, only 13% disagreed with the statement that you should swim towards the drowning person as soon as possible, and most (63%) agreed that the drowning victim's safety was the key concern. When asked about the order of rescue phases and related key points (see Table 4), the poor proportions of correct responses (range 9%–42%) also suggests a lack of understanding. Perhaps of greatest concern was the finding in the pre-intervention survey that very few respondents (9%) identified the need to stay clear of the victim in the rescue phase, a standard mantra in lifeguard training and lifesaving instruction. When asked what they would do if they saw someone in trouble in the water, only one-quarter (26%) of participants gave the correct response of immediately getting flotation to a victim, and more than one-quarter (29%) gave the most dangerous response that they would immediately dive in and rescue the person, a better response to that previously reported where almost half (47%) would dive in as an immediate response (Moran & Stanley, 2013).

Males were more confident than females (males 68%, females 25%) even though no significant differences were evident in the training they had received or knowledge they possessed prior to the water safety programme. Whether this confidence is well founded requires further investigation but, as has been reported in other studies, the tendency for males to overestimate their abilities appears likely (Howland, Hingson, Mangione, Bell, & Bak, 1996; McCool, Moran, Ameratunga, & Robinson, 2008; Moran & Stanley, 2013; Stanley & Moran, in press).

Effect of the 4Rs of Aquatic Rescue *intervention*

Analysis of the post-intervention surveys suggests that knowledge of safe bystander rescue techniques and protocols improved as a consequence of participation in the water safety programme. A significant increase in the correct responses to all but one of the rescue knowledge statements in the post-intervention survey is encouraging (Table 3). The persistence of the misconception that drowning people wave their arms and shout for help suggests that this is a strongly held belief that was not corrected by the intervention. Further emphasis on this critical factor of victim identification is strongly recommended in future bystander water safety programmes. While positive change pre- and post-intervention was evident on dissuading would-be rescuers from immediately diving into the water, most still considered this the correct action; similarly strong emphasis should also be placed on water entry as the last, not first resort in a drowning emergency. Perhaps the most encouraging shift in understanding relates to the necessity to take flotation with them if forced to enter the water, with most of all respondents aware of this crucial message after the programme (pre- 70%, post- 88%).

perceptions of bystander rescue. Gaps exposed in would-be rescuers' knowledge of safe rescue techniques and misconceptions about their ability to cope with an emergency drowning incident suggest that ongoing promotion of education in safe bystander rescue technique is a worthy goal. A linked study to see what changes are made at an individual level to address the causation issue is recommended. To facilitate greater reach in the future, it is recommended that the programme be incorporated into train-the-trainer delivery models for those likely to be first responders to a drowning incident. The loss of life through rescuer drowning is preventable, and too great a threat to be left to altruism and chance.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix B: Examples of public works in the revision of drowning data collection and patient care guidelines

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2015 revised Utstein-style recommended guidelines for uniform reporting of data from drowning-related resuscitation An ILCOR advisory statement☆,☆☆

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ABSTRACT

Background: Utstein-style guidelines use an established consensus process, endorsed by the international resuscitation community, to facilitate and structure resuscitation research and publication. The first "Guidelines for Uniform Reporting of Data From Drowning" were published over a decade ago. During the intervening years, resuscitation science has advanced considerably, thus making revision of the guidelines timely. In particular, measurement of cardiopulmonary resuscitation elements and neurological outcomes reporting have advanced substantially. The purpose of this report is to provide updated guidelines for reporting data from studies of resuscitation from drowning.

Methods: An international group with scientific expertise in the fields of drowning research, resuscitation research, emergency medical services, public health, and development of guidelines met in Potsdam, Germany, to determine the data that should be reported in scientific articles on the subject of resuscitation from drowning. At the Utstein-style meeting, participants discussed data elements in detail, defined the data, determined data priority, and decided how data should be reported, including scoring methods and category details.

Results: The template for reporting data from drowning research was revised extensively, with new emphasis on measurement of quality of resuscitation, neurological outcomes, and deletion of data that have proved to be less relevant or difficult to capture.

Conclusions: The report describes the consensus process, rationale for selecting data elements to be reported, definitions and priority of data, and scoring methods. These guidelines are intended to improve the clarity of scientific communication and the comparability of scientific investigations.

The First International Utstein-style consensus conference on drowning convened in Amsterdam, the Netherlands, in June 2002 to develop guidelines for reporting outcome data related to drowning; these guidelines were published in 2003 [1]. We describe in the present report the results of the Second International Utstein-Style Consensus Conference on Drowning that convened in Potsdam, Germany, in October 2013.

In the 1980s, an international group of investigators in the field of resuscitation research noted a lack of common nomenclature, definitions, and consistency in scientific reports of research regarding sudden cardiac arrest. In response to these problems, the first Utstein conference on resuscitation research took place at the Utstein Abbey in Stavanger, Norway, in June 1990. The conference sought to establish uniform definitions and guidelines for reporting data for research regarding out-of-hospital cardiac arrest [2]. Utstein-style conferences use an established consensus process, endorsed by the international resuscitation community, to create a uniform reporting structure to enable comparison of outcomes. Subsequently, several Utstein-style conferences on out-

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of-hospital cardiac arrest research have taken place to update and refine the original recommendations. Since the first Utstein conference, Utstein-style guidelines have been published for in-hospital resuscitation, trauma resuscitation, drowning resuscitation, disaster resuscitation, and laboratory research in resuscitation [3–8].

The issues discussed at the first 1990 Utstein consensus conference are common to many specialties involved in resuscitation from causes other than primary cardiac arrest. Drowning is one important cause of death that shares many of the same definition and reporting problems as out-of-hospital cardiac arrest research. For example, a systematic review of drowning reports found 20 different definitions for drowning, 13 different definitions for near-drowning, and 13 related terms in the 43 articles reviewed [9]. In addition, 20 inconsistent outcome measures were identified.

In 2002, an international group of scientific investigators, including epidemiologists, and others concerned with resuscitation from drowning convened an Utstein-style consensus conference in Amsterdam at the World Congress on Drowning. The consensus conference developed guidelines for definitions and reporting of data related to drowning, published in 2003 [1]. The report defined drowning as "... a process resulting in primary respiratory impairment from submersion/immersion in a liquid medium. Implicit in this definition is that a liquid/air interface is present at the entrance of the victim's airway, preventing the victim from breathing air. The victim may live or die after this process, but whatever the outcome, he or she has been involved in a drowning incident." The report also defined other terms including the drowning process.

More than 10 years have passed since the first drowning reporting guidelines were published. During that time, resuscitation science has advanced considerably, which makes revision and refining of the guidelines timely. A review of the drowning literature identified 11 studies that used the reporting template from the 2003 publication [10–20]. These reports recommended that additional data elements be added to the Utstein drowning reporting template, such as initial cardiac rhythm, duration of cardiopulmonary resuscitation (CPR), serum potassium level, speed of rewarming, and more detailed neurological assessments.

The objective of the Second International Utstein-style consensus conference on drowning was to reassess and update data that should be reported in studies of drowning resuscitation. In addition, the participants reviewed all data elements in detail to determine priority for data reporting and to review and assess scoring methods and categories.

Methods

A group of international scientists and experts in drowning resuscitation, including representatives of international organizations, were invited to participate in the Second International Utstein-style consensus conference on drowning.

The following organizations were represented at the conference:

- Maatschappij tot Redding van Drenkelingen
- American Heart Association
- European Resuscitation Council
- US Centers for Disease Control and Prevention
- Australia and New Zealand Resuscitation Council
- InterAmerican Heart Foundation
- Heart and Stroke Foundation of Canada

Members were selected on the basis of demonstrated interest and expertise in the area of resuscitation research by having participated in the previous drowning consensus conference or in other resuscitation consensus conferences, having authored Utstein-based reports on drowning, or having served in leadership roles in organizations devoted to the rescue and resuscitation of victims of drowning.

After the consensus group was identified and finalized, data evaluation was performed via a Delphi consensus process [21,22]; a spreadsheet with data elements taken from the first drowning consensus report was sent to participants. Participants were instructed to indicate whether each data element represented core (definitely necessary) or supplementary data and to give the data element a priority score of its importance for research, which could be impacted by the feasibility of collecting the data element.

For each of the original data elements, participants were asked to suggest descriptions, categories, or tests and to suggest alternatives or additions, as appropriate. They were also asked to select a primary review group in which to participate (Prehospital Data, Quality of Resuscitation, or In-Hospital and Outcome Data) and were provided with a list of the most recent literature on the issue. Finally, we asked participants to suggest a research question and to indicate whether the data in the spreadsheet were sufficient to answer the question or whether other data would be needed.

Results from the first round of review were then collected, tabulated, and sent to participants for a second round of review. The second review included priority scores from the first round and new data elements that had been suggested. Participants were instructed to score the data elements in a fashion similar to the first review.

Results from the second review were collected, tabulated, and sent to participants ≈2 weeks before the Second International Utstein-style Consensus Conference on Drowning in Potsdam (Data Supplement Table).

The Potsdam consensus conference participants were organized into the 3 main sections, which met separately. Except for the section chairs and co-chairs, conference participants rotated through each section, spending 1 h in each section. Thus, all participants had an opportunity to engage in discussions in all 3 sections. Section chairs and co-chairs then summarized the results of the consensus and identified items that required further discussion.

All participants, including chairs and co-chairs, met in a plenary session to review the consensus results and to discuss further any remaining items that did not have consensus. Section chairs and co-chairs then summarized the final consensus results after the plenary session.

The results of the Potsdam conference were presented and discussed later that week at the 2013 World Congress on Drowning, Potsdam, Germany, and at the 2013 annual meeting of the European Resuscitation Council in Krakow, Poland. The consensus discussion continued through 2014 and 2015 by e-mail and teleconference. In addition, several members of the writing group of this report (A.H.I., J.B., G.D.P., V.W., V.N., P.M., A.T., A.J.H., M.F.H., B.L., L.Q., J.-T.G.) participated in the International Liaison Committee on Resuscitation (ILCOR) 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations (CoSTR) conference, which included sessions on drowning and basic life support, in Dallas, TX, January 31 to February 3, 2015. We have attempted to align recommendations in this report with CoSTR recommendations whenever possible.

Results

Recommended data to report

The Second International Utstein-style Consensus Conference on Drowning developed reporting tables to help investigators report methods and results for drowning research. A summary of

Table 1
Victim Information.

Data Element	Priority	Description	Categories
Victim identifier	**Core**	A number, code, or other information for unique identification of each victim	For data collection, not reporting
Sex	**Core**	Sex	Male/female
Age	**Core**	Record birthdate if known. If the birthdate is unknown but the age is known or can be estimated, record age in years.	Birthdate; age in years
Race/ethnicity	*Supplementary*	Race, ethnicity	Race: White, African, African American, Asian Ethnicity: Hispanic, non-Hispanic
Incident date and time of day	**Core**	Date/time	Use 24-h clock time
Precipitating event	**Core**	Is there evidence to suggest a precipitating event or factor is causally related to the drowning? Evidence may be obtained at the scene or from hospital or postmortem history/toxicology tests.	One or more: Alcohol; drug intoxication; traumatic injury; seizures or syncope; suspected cardiac cause; suicide; drowning related to boating accident, submerged vehicle, or flood; hyperventilation/breath holding; primary circulatory arrest; other (specify); unknown
Was the face submerged (underwater) at any time before or during rescue?	**Core**	A drowning occurs when a liquid covered the mouth and nose and prevented air from entering the lungs.	Y/N/U
Preexisting illness	**Core**	Preexisting illness causing impairment	Seizure disorders, chronic heart disease, chronic lung disease, chronic neurological disease, none, unknown

"Resident of city, county, state, and country" was in the 2003 guidelines and is no longer included even as supplementary data in the present guidelines. Y/N/U indicates yes/no/unknown.

Table 2
Scene Information.

Data Element	Priority	Description	Categories
Water temperature	**Core**	Was the water icy or non-icy? Report the water temperature if known.	Icy or non-icy
Who witnessed the drowning	**Core**	Did someone see the person going underwater? If not, the event should be labeled "unwitnessed."	Unwitnessed Witnessed by a bystander Witnessed by a lifeguard Witnessed by EMS
Bystander CPR	**Core**	Did a bystander (non-EMS person) perform CPR?	Y/N/U
	Supplementary	CPR method	Chest compressions and ventilation Chest compressions only Ventilation only Number of initial breaths
Bystander ventilation	**Core**	Was ventilation given?	Y/N/U
Did a trained first responder perform CPR or provide ventilation only?	**Core**	Did a lifeguard or other trained first responder with a duty to treat perform CPR or provide ventilation only?	CPR: Y/N/U Ventilation only: Y/N/U
Vital status at first trained responder/EMS assessment	**Core**	AVPU, ABC, GCS	Response (AVPU, ABC, or GCS) Normal breathing (Y/N/U) Pulse (Y/N/U)
Initial cardiac rhythm	**Core**	Cardiac rhythm from monitor or ECG	Ventricular fibrillation Ventricular tachycardia Pulseless electrical activity Asystole Other
Vital signs	*Supplementary*	Devices are necessary to measure vital signs	Heart rate Blood pressure Temperature Spo_2
Pulmonary status	*Supplementary*	Assess severity of lung injury	Normal lung examination; patient is coughing; unilateral rales; bilateral rales
Type of water/liquid (eg, salt/fresh/chemical/other)	*Supplementary*	In what type of liquid did the drowning occur?	Fresh water, salt water, water containing chemicals
Body of water (eg, river/ocean/swimming pool)	*Supplementary*	Where did the drowning occur?	Bathtub, swimming pool, ocean, lake, river, creek, bayou, pond, bucket, hot tub, or other body or container of liquid? This list should be modified as needed to include local hazards.

The following data elements that were present in the 2003 guidelines have been deleted from the present guidelines: Loss of consciousness, pre-EMS resuscitation, unconscious when removed from the water, was resuscitation attempted before arrival of EMS? was EMS called? was an EMS vehicle dispatched? was cyanosis present? These elements have either been replaced with updated elements or are considered unreliable (eg, cyanosis could be a result of hypoxia or submersion in cold water).
ABC indicates alert, blunted, coma; AVPU, alert, responds to verbal stimuli, responds to painful stimuli, unresponsive; CPR, cardiopulmonary resuscitation; EMS, emergency medical services; GCS, Glasgow Coma Scale; and Y/N/U, yes/no/unknown.

data to be reported is shown in Tables 1–7. **Core** data (shown in **bold** typeface) should be reported in all studies; *supplementary* data (shown in *italic* typeface) are recommended but not essential. **Core** data were considered important and feasible to be reported in most systems worldwide. We expect that almost any investigator can reliably gather **core** data so that a minimum universal worldwide data set is feasible. *Supplementary* data were considered important but typically comprised information that is difficult to capture reliably (eg, time points and time intervals) or may be nonessential.

In this update, we deleted some items that were listed in the prior edition because the items were considered to be unreli-

Table 3
Pre-EMS Scene Information (Lifeguards and First Responders With a Duty to Treat).

Data Element	Priority	Description	Categories
Level of medical knowledge of the lifeguard delivering the patient care	**Core**	Level of training and certification	Paramedic Emergency Medical Technician First Responder certified Other (specify)
Interventions used by lifeguard or first responder during resuscitation	**Core**	Type of equipment used	Bag-mask device Supraglottic airway device Endotracheal intubation Other (specify)
Was the lifeguard or first responder performing CPR/patient care the same person who performed the water extrication (rescue)?	*Supplementary*	Describe rescuer(s)	Y/N/U
Number of lifeguards or first responders attending the patient	*Supplementary*	Number	Number of lifeguards/first responders attending the patient
If drowning was in the ocean or river, what were the water conditions?	*Supplementary*	Water conditions	Waves and currents vs flat water Moving water on a river with strong currents vs nonmoving water
How was the person removed from the water (if known)?	*Supplementary*	Specify method of removal	Who removed the victim? Lifeguard, first responder, citizen responder (bystander) How was the victim removed? Swimming, boat, personal watercraft, jet ski, rescue board, helicopter/air rescue

CPR indicates cardiopulmonary resuscitation; EMS, emergency medical services; and Y/N/U, yes/no/unknown.

Table 4
Time Points and Time Intervals From First Responder or EMS Data.

Data Element	Priority	Description	Categories
Time face/airway seen underwater	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time victim was removed from water	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time of fi trained responder/EMS treatment	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time CPR first begun	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time ROSC was achieved	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time first conscious/awake	**Core**	hh:mm:ss or unknown	Hours:minutes:seconds
Time intervals derived from time points			
Submersion duration (face underwater)	**Core**	Derived from time underwater to time of removal/commencing resuscitation	Minutes
Underwater to first treatment or CPR interval	**Core**	Derived from time underwater to time of first EMS treatment or CPR	Minutes

Times should be calculated by reference to fixed/measured time points (eg, EMS call time, EMS arrival time, EMS departure time). Duration underwater, time taken for removal from water, and time to CPR or first treatment is the interval: [←Duration Underwater→][←Removal→][←Initial EMS treatment or CPR→].
CPR indicates cardiopulmonary resuscitation; EMS, emergency medical services; hh, hours; mm, minutes; ROSC, return of spontaneous circulation; and ss, seconds.

able, difficult to capture, or had some other problem. Additionally, some data items were changed from **core** to *supplementary* or the other way around. There was some discussion regarding the meaning of the terms *immersion* and *submersion*, which were recommended in the 2003 guidelines. Some thought the term *immersion* was ambiguous because there are many situations that could be included under this term that are not associated with drowning. Immersion often signifies that the head is up and out of the water, whereas the rest of the body is immersed [23,24]. Drowning can occur with aspiration of even a small volume of water; even a wave splashing over the face could lead to drowning but often does not. However, the term *submersion* indicates that the head and face are underwater, which leads to drowning if the airway is submerged long enough. The term *submersion* reflects the most important aspect of drowning, namely, that liquid covering the nose and mouth prevents air from entering the lungs. We decided to retain *submersion* because it is most applicable to studies of resuscitation from drowning.

There are 3 new tables in this edition, 1 related to rescue and treatment by lifeguards (Table 3), 1 specifically devoted to time points and time intervals (Table 4), and 1 focused on resuscitation quality (Table 8).

Template

Victim information (Table 1)
Core data

1. **Victim identifier:** A number, code, or other information for unique identification of each victim.
2. **Sex:** Male or female.
3. **Race and ethnic categories:** *Supplementary: Race/Ethnicity.* These characteristics have been important risk factors and issues for preventive interventions. Reported differences likely reflect differences in exposure rates, risk factors, and socioeconomic status, not differences in physiological responses. Racial or ethnic information may be difficult to ascertain clinically (eg, Hispanic versus white in the United States) or delineate (eg, mixed marriages and names).
4. **Age:** Record birthdate, if known. If the birthdate is unknown but the age is known, record age in years. Age may be estimated.
5. **Incident date and time of day.**
6. **Precipitating event:** Report if a precipitating event or factor is known that is causally related to the drowning. Although the cause of drowning is frequently unknown, the type of precipitating event can have a powerful influence on the patient's care and outcome.
7. **Was the face submerged (face underwater or covered in water) at any time before or at the time of rescue (new)?** We recommend using the objective phrase indicating that the face (nose and mouth) was underwater or covered in water in a manner that prevents air from entering the lungs.
8. **Preexisting illness:** List preexisting illness such as psychological, developmental, or medical disorders. It may be difficult to know whether the drowning was related to the illness, but the

Table 5
Hospital Course, Core Data.

Data Element	Priority	Description	Categories
Date and time of hospital arrival	**Core**	Date and time	DD:MM:YY:hh:mm:ss or unknown
CPR ongoing at hospital arrival	**Core**	Was CPR ongoing when patient entered the hospital?	Y/N/U
Duration of CPR	**Core**	Record the total number of minutes that CPR was performed regardless of where it was stopped (scene, emergency department, hospital)	Minutes or unknown
First documented vital signs after hospital arrival	**Core**	Vital sign measurements	Temperature (centigrade) Heart rate Blood pressure (mm Hg) Respiratory rate (if spontaneous) Oxyhemoglobin saturation (%)
First cardiac rhythm after hospital arrival	**Core**	Cardiac electrical rhythm on cardiac monitor or ECG	Ventricular fibrillation Ventricular tachycardia Pulseless electrical activity Asystole Other
Initial hospital neurological examination	**Core**	GCS score or AVPU	GCS: Eyes, verbal, motor (total 3–15) or AVPU
Arterial blood gas analysis	**Core**	Arterial blood gas results	pH, Pao_2, $Paco_2$, base deficit
Pulmonary edema/ARDS	**Core**	Were bilateral lung opacities present on admission radiograph or within 1 wk of drowning?	Y/N/U
Airway and ventilation requirements	**Core**	What was the highest level of respiratory support the patient required during hospitalization?	(1) Nothing; (2) supplementary O_2; (3) noninvasive ventilation support; (4) conventional invasive ventilation support; (5) nonconventional invasive ventilation support
ICU admission	**Core**	Was the patient admitted to the ICU?	Y/N/U
Induced hypothermia	**Core**	Was the patient treated with induced hypothermia?	Y/N/U
Temperature management	**Core**	Was the patient treated with targeted temperature management?	Y/N/U
Temperature peak/trough (new)	**Core**	Highest and lowest temperatures in first 96 h after ROSC	Initial temperature Highest temperature Lowest temperature Unknown
Serum glucose levels	**Core**	Serum glucose levels in first 24 h after ROSC Was normoglycemia maintained?	Initial Highest Lowest Unknown Y/N/U
Hypotension	**Core**	Did the patient have 2 documented episodes of hypotension (defined as systolic blood pressure <90 mm Hg for adults and age adjusted for children)?	Y/N/U
Circulatory support	**Core**	Was continuous vasopressor/inotropic support initiated?	Y/N/U
ECMO/CPB	**Core**	Was the patient treated with ECMO or CPB?	Y/N/U
Neurological function	**Core**	Best GCS during hospitalization	Number (range, 3–15)
In-hospital resuscitation	**Core**	Did the patient have a cardiac arrest requiring chest compressions after hospital admission?	Y/N/U
Complicating illness of drowning	**Core**	Report if the victim developed complications/illnesses	Check all that apply: Acute respiratory distress syndrome Disseminated intravascular coagulation Pneumonia Pancreatitis Acute kidney injury Shock Multiple system organ failure Sepsis Electrolyte disturbance Glucose disturbance Other Unknown

ARDS indicates acute respiratory distress syndrome; AVPU, alert, responds to verbal stimuli, responds to painful stimuli, unresponsive; CPB, cardiopulmonary bypass; CPR, cardiopulmonary resuscitation; DD:MM:YY:hh:mm:ss, day, month, year, hours, minutes, seconds; ECMO, extracorporeal membrane oxygenation; EMS, emergency medical services; GCS, Glasgow Coma Scale; ICU, intensive care unit; ROSC, return of spontaneous circulation; and Y/N/U, yes/no/unknown.

illness should be abstracted from hospital data, if it is known. (This was previously *supplementary* data in 2003).

Although drowning has traditionally been an injury involving healthy people, changing demographics and recreational interests may contribute to drowning in nonhealthy people. With the increasing prevalence of chronic diseases and aging populations, cardiac, metabolic, and psychiatric conditions may predispose to drowning [25,26].

Note: "Resident of city, county, state, and country" was in the 2003 guidelines and is no longer included even as supplementary data in the present guidelines because the relationship with resuscitation outcomes is unclear.

Scene information (Table 2)

Core data

1. **Water temperature:** Was the water icy or non-icy? The only water temperatures associated with possible improved outcomes have been icy waters [27–29]. Report the water temperature, if known or estimated.
2. **Was the drowning witnessed?** Did someone see the drowning victim enter the water or struggling before disappearing

Table 6
Hospital Course, *Supplementary* Data.

Data Element	Priority	Description	Categories
If CPR was not ongoing on arrival, why?	*Supplementary*	Why was CPR not ongoing on arrival?	Pulse present Patient was considered deceased Unknown
Time CPR stopped in emergency department	*Supplementary*	Date and time	DD:MM:YY:hh:mm:ss or unknown
Number of defibrillation attempts after hospital arrival	*Supplementary*	Number of shocks	Number
Initial neurological function: FOUR score	*Supplementary*	Document the patient's admission FOUR score47,48	FOUR score or unknown
Serum lactate	*Supplementary*	Document the patient's serum lactate levels (mg/dL) (evidence of tissue hypoxia)	Initial Highest Lowest Unknown
Potassium level	*Supplementary*	Document the potassium levels (mEq/L); this can be obtained from either a blood gas or chemistry panel	Initial Highest Lowest Unknown
Prior substance abuse	*Supplementary*	Omit here if already documented under victim information	Y/N/U
Blood alcohol level	*Supplementary*	Document the initial blood alcohol level	mEq/L or unknown
Oxygenation	*Supplementary*	What was highest arterial oxygen tension (Pao_2) in the first 96 h after ROSC? What was lowest Pao_2 in the first 96 h after ROSC?	Initial Pao_2 Highest Pao_2 Lowest Pao_2 Unknown
Temperature goal	*Supplementary*	What was the target temperature and temperature range (degrees centigrade)?	Degrees centigrade or unknown
Neurological function tests	*Supplementary*	Did the patient have neuromonitoring/neuroimaging or biomarker measurement?	Yes: Computed tomography, magnetic resonance imaging, electroencephalography, evoked potentials, intracranial pressure, microdialysis, or tissue oxygen monitoring/serum biomarkers No Unknown

The following data elements that were present in the 2003 guidelines have been deleted from the present guidelines: pupillary reaction (because an abnormal reaction has many possible causes) and toxicology testing (because this is not universally available).
CPR indicates cardiopulmonary resuscitation; DD:MM:YY:hh:mm:ss, day, month, year, hours, minutes, seconds; FOUR, Full Outline of Unresponsiveness; and Y/N/U, yes/no/unknown.

Table 7
Disposition.

Data Element	Priority	Description	Categories
Date of hospital discharge	**Core**	Document the date of discharge from the hospital	DD:MM:YY or unknown
Vital status at discharge	**Core**	Did the patient survive to hospital discharge?	Y/N
Cause of death, if patient did not survive	**Core**	What were the causes of death?	Fill in causes per clinician, such as respiratory distress syndrome, disseminated intravascular coagulation, intracranial hypertension, electrolyte disturbances, acute renal failure, seizures, sepsis, or myocardial failure
Neurological outcome at hospital discharge, if patient survived	**Core**	Use an age-appropriate validated scoring system	CPC scale,50 OPC scale,50 pediatric CPC scale,51 or pediatric OPC scale51 or modified Rankin score52,53
A. If patient died in the hospital:			
How did patient die?	*Supplementary*	How did the patient die?	Brain death with withdrawal of life support Cardiac arrest without ROSC
Was an autopsy performed?	*Supplementary*		Y/N
Channelopathy evaluation?	*Supplementary*	Did the patient have an evaluation for cardiac channelopathies?	Y/N/U
B. If patient survived to hospital discharge:			
Neurological and quality-of-life outcomes 6 mo after hospital discharge	*Supplementary*	Use an age-appropriate validated scoring system	CPC scale, OPC scale, pediatric CPC scale or pediatric OPC scale, or modifi Rankin score Unknown

The following data elements that were present in the 2003 guidelines have been deleted from the present guidelines: How was the cause of death determined? Was a forensic investigation performed and was a forensic cause uncovered (suicide, murder)? Other injuries and morbidities.
CPC indicates Cerebral Performance Category; DD:MM:YY, day, month, year; OPC, Overall Performance Category; ROSC, return of spontaneous circulation; and Y/N/U, yes/no/unknown.

underwater? If not, the event should be labeled "unwitnessed." In drowning, it is not possible to witness the moment of cardiac arrest, which can happen before, during, or after drowning [30].

3. **Was bystander CPR performed?** Did a bystander (non-emergency medical services [EMS] person) perform initial CPR? Yes/No. If yes, did the bystander perform CPR with ventilation? Yes/No. *Supplementary: CPR Method.*
4. **Trained first responder:** Did a trained first responder perform CPR? Did a lifeguard or other trained responder with a duty to treat perform CPR (Yes/No) or provide ventilation only (Yes/No)?
5. **Vital status at first trained responder/EMS assessment:** The consensus group recommended a focus on vital indicators of outcome: **Was the drowning victim responsive** (ABC [alert,

Table 8
Quality of Resuscitation Factors.

Data Element	Priority	Description	Categories
Method of administering ventilation	**Core**	Type of equipment used	Mouth-to-mouth Bag mask Supraglottic airway device Endotracheal intubation Unknown
Ventilation rate	*Supplementary*	Breaths/min	Number or unknown
Chest compression rate	*Supplementary*	Chest compression rate measured during compressions, usually measured as average rate for each minute	Rate/min
Chest compression fraction	*Supplementary*	Proportion of time doing compressions for each minute	Percent or proportion or unknown
Chest compression depth	*Supplementary*	Depth of chest compressions, usually measured as average depth for each minute Other measurements: maximum depth	In mm or cm or unknown
Preshock pause interval	*Supplementary*	Interval between last chest compression and the shock	Seconds or unknown

Note: The following disposition data elements that were present in the 2003 guidelines have been deleted from the present guidelines: How was the cause of death determined? Was a forensic investigation performed and was a forensic cause uncovered (suicide, murder)? Other injuries and morbidities.

blunted, comatose], AVPU [alert, responds to verbal stimuli, responds to painful stimuli, unresponsive [31]], or GCS [Glasgow Coma Scale [32]] scores) and **breathing normally**, and was a **pulse palpable**? The importance of actual respiratory and heart rates and their impact on resuscitation outcome is unknown; therefore, we recommend that both be collected as *supplementary* data.

6. **Initial cardiac rhythm (new):** Report the initial cardiac rhythm from a cardiac monitor or an ECG.

Supplementary data

7. *Vital signs at first EMS assessment*: Report heart rate, blood pressure, temperature, peripheral capillary oxygen hemoglobin saturation (Spo_2, usually calculated with a pulse oximeter), and pupillary reaction to light.
8. *Pulmonary status at first EMS assessment (new):* When the patient is breathing, assess severity of lung injury. Such assessment could provide an approach to the stratification of the severity of drowning [33,34]. The severity of injury should be categorized; for example, report whether results of the lung examination are normal and whether the patient is coughing, and report the presence of unilateral rales or bilateral rales.
9. *Type of water/liquid*: Drowning in heavily contaminated water or water that contains chemicals may result in additional complications such as infection and pneumonitis [35].
10. Body of water.

Pre-EMS scene information (Table 3)

Lifeguards and other trained first responders with a duty to treat are often among the first people to attempt rescue and resuscitation of the drowning victim. In view of the great importance of these rescuers, we have added Table 3 to provide the opportunity for researchers to add additional detail, if applicable, to reports on drowning.

The following data elements that were present in the 2003 guidelines have been revised or deleted from the present guidelines: Loss of consciousness; pre-EMS resuscitation; unconscious when removed from the water; was resuscitation attempted before arrival of EMS? was EMS called? was an EMS vehicle dispatched? was cyanosis present? These elements have either been replaced with updated elements or are considered unreliable (eg, cyanosis could be a result of hypoxia or submersion in cold water). Water temperature was previously supplementary and is now core data.

Time points and intervals from EMS data (Table 4)

A general discussion took place during the meeting regarding the use of time points and time intervals. When available with sufficient accuracy, time points enable accurate calculation of time intervals. Often, data on the exact time points of interest are unavailable. Time intervals can be estimated but are less reliable. In the end, conferees recommended that if time points are unavailable, then estimated time intervals should be reported and the manner of estimation noted.

Core data

1. **Time face was first seen to be underwater.**
2. **Time victim was removed from water.**
3. **Duration underwater (see submersion duration):** The time interval or duration that the victim was underwater is the most important predictor of outcome in drowning, because it represents the amount of anoxia; it should be recorded, if possible [36–38]. Although the submersion interval is seldom documented with a timepiece such as a stopwatch, the estimate of time intervals (eg, less than or greater than 5–6 min; less than or greater than 10–11 min; less than or greater than 15–20 min; and >25 min) has proven to be the most important predictor of outcome [30,35,39–41]. Duration underwater is derived from the time the face was first seen to be underwater to the time of removal from the water. Obtain the estimated time in minutes from those closest to the scene or who talked with those at the scene. Cross-referencing with emergency call and ambulance arrival times (usually recorded centrally) can be helpful to determine time estimates.
4. **Time of first trained responder/EMS treatment:** The first EMS treatment may or may not be CPR and represents a point when "high-quality" medical intervention could be assured to have begun.
5. **Time trained responder/EMS started CPR (resuscitation) in the field:** Resuscitation is defined as the act of trying to maintain or restore life by establishing and/or maintaining breathing and circulation through CPR, defibrillation, and other related emergency care.
6. **Time ROSC achieved.**
7. **Time first conscious/awake.**
8. **Face submerged (underwater) to first treatment/CPR interval:** The time of the first resuscitation attempt is important because it is another indicator of the duration of anoxia. Furthermore, in both cardiac arrest and drowning studies, intervals from drowning or cardiac arrest to CPR are known to affect outcome [36–38,42–44].

Hospital course, core data (Table 5)

The core data included here have been expanded from the list included in 2003.

Core data

1. **Date and time of hospital arrival:** This may include time of arrival in an emergency department or, if directly admitted from the scene, to another type of inpatient care area.

2. **CPR ongoing at hospital arrival (new)?** Was CPR being administered when the patient arrived at the hospital door?
3. **Duration of CPR:** The total number of minutes CPR was provided during the initial cardiac arrest, regardless of where it was stopped (scene, emergency department, or hospital). Duration of CPR has predicted outcome [16,36].
4. **First documented vital signs after hospital arrival:** Report temperature, heart and respiratory rate, blood pressure (systolic and diastolic), oxygen hemoglobin saturation, and pupillary light reaction. If blood pressure is too low to measure, report whether the pulse is palpable. If blood pressure is sufficient to produce peripheral pulses, the oxyhemoglobin saturation (Spo_2) may be measured with a pulse oximeter.
5. **First cardiac rhythm after arrival at hospital:** Cardiac electrical rhythm noted on a cardiac monitor or ECG.
6. **Initial hospital neurological examination:** Report results of the neurological examination when the victim first arrived in the emergency department using a validated, age-appropriate system (eg, ABC, AVPU, or GCS scoring systems). Specify the scale used.
7. **Arterial blood gas analysis:** Report arterial blood gas tensions and pH, especially in victims who are unconscious or who have oxyhemoglobin saturations <95% when breathing room air.
8. **Pulmonary edema or acute respiratory distress syndrome (new):** Did the patient have signs of radiographic bilateral opacities not fully explained by effusions, lobar/lung collapse, nodules within 1 week of the drowning, or other signs of acute respiratory distress syndrome? The Berlin definition of acute respiratory distress syndrome has additional detail [45].
9. **Airway and ventilation requirements:** What was the highest level of respiratory support the patient required during the hospitalization? Choices include nothing, supplementary O_2, noninvasive ventilation support, conventional invasive ventilation support, nonconventional invasive ventilation support, extracorporeal membrane oxygenation, and cardiopulmonary bypass.
10. **Intensive care unit admission (new).**
11. **Induced hypothermia (new).**
12. **Temperature management (new):** Was the patient treated with a protocol aimed at targeted temperature management [46] (defined as an active therapy to achieve and maintain a specific target temperature for a defined duration)? Yes, No, or Unknown. If yes, what was the target temperature range (degrees centigrade)?
13. **Temperature peak and trough (new):** What were the initial, highest, and lowest temperatures in the first 96 h after return of spontaneous circulation (ROSC)?
14. **Serum glucose levels:** What were the initial, highest, and lowest serum glucose levels in the first 24 h after ROSC? Was normoglycemia maintained? Yes, No, or Unknown.
15. **Was hypotension documented ≥2 times during hospitalization (new)?** Did the patient have ≥2 documented episodes of hypotension (defined as systolic blood pressure <90 mm Hg for adults and age adjusted for children)? Yes, No, or Unknown.
16. **Circulatory support (new):** Was continuous vasopressor/inotropic support initiated? Yes, No, or Unknown.
17. **Cardiopulmonary bypass (new).**
18. **Neurological function:** What was the best GCS (or pediatric equivalent) during hospitalization (score range 3–15)?
19. **In-hospital resuscitation (new):** Did the patient have another cardiac arrest requiring attempted resuscitation after hospital admission? Yes, No, or Unknown.
20. **Complicating illness of drowning (new):** Check all that apply.

Hospital course, supplementary data (Table 6)
Supplementary data

1. *If CPR was not ongoing on arrival at the hospital, what was the reason (new)?* Was CPR not indicated because the patient had a pulse, or was the patient deceased?
2. *Time CPR stopped in the emergency department (new).*
3. *Number of defibrillations administered (new):* If the patient was defibrillated after hospital arrival, document the number of shocks the patient received.
4. *Initial neurological function (new):* FOUR score (Full Outline of Unresponsiveness) [47,48].
5. *Serum lactate:* Document the patient's initial and highest serum lactate levels, because this can provide evidence of tissue hypoxia.
6. *Potassium level:* Document the initial, highest, and lowest serum or blood potassium levels on admission (in mEq/L). This can be an important predictor of outcome [49].
7. *Toxicology screening or history of prior substance abuse.*
8. *Blood alcohol level:* What was the first documented blood alcohol level?
9. *Arterial oxygen tension (Pao_2):* What was initial, lowest, and highest Pao_2 in the first 96 h after ROSC?
10. *Temperature goal (new):* What was target temperature range and temperature range (degrees centigrade)?
11. *Neurological function tests (new):* Did the patient have neuromonitoring/neuroimaging or biomarker measurement (computerized tomography, magnetic resonance imaging, electroencephalography, evoked potentials, intracranial pressure, microdialysis, or tissue oxygen monitoring/serum biomarkers)?

Disposition (Table 7)
Core data

1. **Date of hospital discharge.**
2. **Vital status at discharge:** Did patient survive to hospital discharge? Yes, No, or Unknown.
3. **Cause(s) of death (new):** Describe the factors contributing to death associated with drowning, such as alcohol or other drug intoxication, cardiac arrhythmia (prolonged QT), or myocardial infarction. Indicate clinical causes listed in the medical record, such as respiratory distress syndrome, disseminated intravascular coagulation, intracranial hypertension, electrolyte disturbances, lucose disturbances, acute renal failure, seizures, sepsis, or myocardial failure.
4. **Neurological outcome at hospital discharge:** Use an age-appropriate validated scoring system such as the Cerebral Performance Category scale [50], Overall Performance Category scale [50], pediatric Cerebral Performance Category scale [51] or pediatric Overall Performance Category scale [51], modified Rankin score [52,53], or other.

Supplementary data
A. If patient died in the hospital:

1. *How did the patient die (if applicable) (new):* Multiorgan failure, intractable shock, recurrent cardiac arrest without ROSC, brain death, withdrawal of life support.
2. Was an autopsy performed?
3. *Channelopathy evaluation (new):* Did the patient have an evaluation for cardiac channelopathies? Yes, No, or Unknown.

B. If patient survived to hospital discharge:

4. *Neurological and quality-of-life outcomes 6 months after discharge (new):* Report quality of life at the time of discharge from the hospital using an age appropriate validated scoring system

(eg, Cerebral Performance Category scale, Overall Performance Category scale, pediatric Cerebral Performance Category scale or pediatric Overall Performance Category scale, or modified Rankin score).

Quality of resuscitation factors (Table 8)

Over the past decade, a number of studies have demonstrated the importance of factors related to CPR quality (eg, rescuer compression rate, depth of chest compressions, compression fraction, and preshock pause interval [ie, time elapsed between last compression and shock delivery during attempted defibrillation]) and their effect on ROSC and neurologically intact survival to hospital discharge in patients with out-of-hospital cardiac arrest [54–58]. Because drowning is primarily a respiratory problem, information regarding the quality of ventilation is important. Data regarding CPR quality for each patient can be displayed in real time and recorded for later analysis by many commercially available automated external defibrillators and monitor-defibrillators used during resuscitation. These data are important for quality assurance and quality improvement programs that have been used to improve survival from sudden cardiac arrest in prehospital systems [59].

The following factors are considered important indicators of resuscitation quality:

1. **Method of administering ventilation:** Mouth-to-mouth, bag-mask, supraglottic airway device, or endotracheal intubation.
2. *Ventilation rate:* Breaths per minute
3. *Chest compression rate:* Chest compression rate measured during compressions
4. *Chest compression fraction:* Proportion of time compression was performed for each minute of total resuscitation time (percent or fraction of resuscitation).
5. *Chest compression depth:* Usually measured as average depth for each minute
6. *Preshock pause interval:* Interval (in seconds) between the last chest compression and shock delivery when defibrillation is attempted.

Discussion

This report describes the results of the Second International Utstein-style Consensus Conference on Drowning that convened in Potsdam, Germany, in October 2013, as well as additional conferences and meetings through 2014 and 2015. This report is an update of the 2003 publication [1], is based on a 3-stage Delphi consensus process that was used to arrive at consensus recommendations, and expands the number of reporting parameters from 47 to 68 on the basis of advances in resuscitation science and study experience since the first report. The conference had wide geographic representation, including participation from members residing in Austria, Australia, Brazil, Canada, Denmark, Germany, the United Kingdom, Korea, Japan, New Zealand, the Netherlands, and the United States of America, representing a number of international organizations. Drowning is a neglected public health issue with a significantly disproportionate burden in low- and middle-income countries [60]. In low- and middle- income nations, rescue, resuscitation, emergency response systems, and hospital care may be immature, rare, or absent. Several participants were acquainted with the problem of drowning in developing countries and contributed factors for reporting related to the environment that might be found in developing countries.

The data suggested for reporting in studies of resuscitation from drowning are thought to be important demographic, patient-centered factors, as well as factors related to EMS response and resuscitation. We clarified times and time intervals that are related to outcomes in a separate table (Table 4). Factors related to severity of illness, in-hospital resuscitation, and advanced care are also recommended for reporting. Table 6 now includes data related to hypothermia or temperature management, which could have an impact on mortality and neurological outcomes after spontaneous ventricular fibrillation cardiac arrest, although this remains under investigation with regard to the specific relevance to drowning [46,61–63].

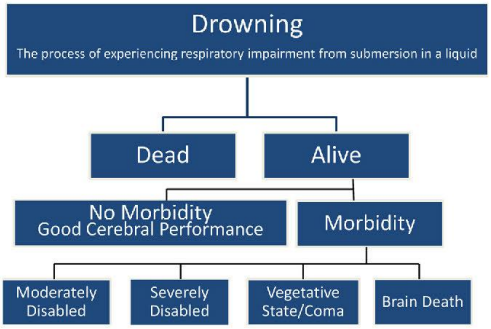

Fig. 1. Possible scheme for tracking outcomes.

Many drowning events require only ventilation for resuscitation, and many patients are not transported to the hospital. New data elements have been added to the reporting template that include events in which drowning victims required ventilation only, may have been treated by first responders but not by EMS, or may not have been transported to a hospital (Tables 3–5).

The quality of prehospital resuscitation has emerged in the past decade as a factor associated with ROSC and survival to hospital discharge, and it is recommended that those systems capable of collecting data on this factor do so (Table 8). Drowning prevention remains the most important strategy in all nations, regions, and communities to save lives and minimize the tragic impact of drowning.

Outcomes

A number of outcomes are important after drowning, such as ROSC, admission to hospital, survival to hospital discharge, and short- and long-term neurological function. When death is an outcome, it can be difficult to assign drowning as a specific cause, especially if the person was hospitalized and had other intervening illnesses before death. The original report used the term "death due to drowning" if a person died after drowning, even if other illnesses occurred before death. The present report has revised that term to "drowning-related death" and recommends inclusion of complications during the hospital stay that have contributed to morbidity and mortality. We suggest a possible scheme for tracking outcomes (Fig. 1).

Summary

A group of international experts agreed on these modifications to the recommended elements for unified reporting of outcome data in studies of resuscitation from drowning. These guidelines are intended to improve the clarity of scientific communication and the comparability of scientific investigations.

The Second International Utstein-style consensus welcomes comments or questions regarding these recommendations.

Disclosures

Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Reviewer Disclosures

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David M. McMullan	Seattle Children's Hospital	None	None	None	None	None	None	None
Natalie Hood	Monash Medical Centre (Australia)	None	None	None	None	None	Surf LifeSaving Australia (National Medical Advisor)*	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

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AUSTRALIAN RESUSCITATION COUNCIL

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GUIDELINE 9.3.2

RESUSCITATION OF THE DROWNING VICTIM

INTRODUCTION

Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Drowning outcomes are classified as death, morbidity and no morbidity – the latter two now referred to as "non-fatal drownings".[1]

The most important consequence of drowning is interruption of the oxygen supply to the brain. Early rescue and resuscitation by trained first responders or first aiders at the scene offer the victim the best chance of survival.

POSSIBLE SEQUENCE OF EVENTS

- Immersion of the face in water (or other liquid). Water entering the mouth is spat out, swallowed or aspirated.
- Breath-holding, usually lasting no more than a minute.
- Vigorous breathing efforts. These may continue, even after loss of consciousness. Some amount of water is aspirated into the airways causing coughing and sometimes laryngeal spasm, which temporarily prevents further water entering the lungs.
- Swallowing of air and water, often in large amounts. This usually causes vomiting or regurgitation of stomach contents, which may be aspirated into the lungs.
- Respiratory impairment causes brain hypoxia, leading to unconsciousness and cessation of breathing efforts.
- The heart rate initially increases with exercise and panic. With hypoxia, the heart rate and blood pressure begin to fall, progressing finally to a cardiac arrest, requiring CPR.

MANAGEMENT

- Remove the victim from the water as soon as possible but do not endanger your own safety. Throw a rope or something to provide buoyancy to the victim. Call for help; plan and effect a safe rescue.

- In minor incidents, removal from the water is often followed by coughing and spontaneous resumption of breathing.

- In more serious incidents, assess the victim. If unconscious or not breathing normally, commence resuscitation following the Australian Resuscitation Council and New Zealand Resuscitation Council Basic Life Support flow chart . (Guideline 8).

- Assess the victim on the back with the head and the body at the same level, rather than in a head down position. This decreases the likelihood of regurgitation and vomiting and is associated with increased survival.[2]

- The victim should not be routinely rolled onto the side to assess airway and breathing. Assessing the airway of the victim without turning onto the side (i.e. leaving the victim on the back or in the position in which they have been found) has the advantages of simplified teaching, taking less time to perform and avoids movement (ARC Guideline 4).

- The exceptions to this would be where the airway is obstructed with fluid (water or blood) or particulate matter (sand, debris, vomit). In this instance the victim should be promptly rolled onto the side to clear the airway. The mouth should be opened and turned slightly downwards to allow any foreign material to drain using gravity (ARC Guideline 4).

- Vomiting and regurgitation often occur during the resuscitation of a drowned victim. If the victim has been rolled to the side to clear the airway, then reassess their condition. If breathing commences, the victim can be left on the side with appropriate head tilt. If not breathing normally, the victim should be promptly rolled onto the back and resuscitation recommenced as appropriate (ARC Guideline 4).

- Avoid delays or interruptions to CPR. Do not empty a distended stomach by applying external pressure. Do not attempt to expel or drain clear water or frothy fluid that may re-accumulate in the upper airway during resuscitation.

- Victims who appear to have been successfully rescued and resuscitated require close monitoring to detect a relapse into cardiopulmonary arrest. This can occur in the minutes or hours following return of spontaneous circulation and breathing, due to persisting lung damage and hypoxic injury to the heart.[3]

- Call an ambulance for all victims of an immersion event, even if seemingly minor or the victim appears recovered.

NOTES

Oxygen
The administration of oxygen is beneficial in the resuscitation of drowned victims, but resuscitation efforts should not be delayed while waiting for oxygen equipment to become available.

Medical conditions leading to sudden incapacitation in the water
Not all water related deaths are primary drowning. Sudden incapacitation leading to swim failure, unconsciousness and subsequent water in the airway can occur due to heart attacks, cardiac rhythm disturbances, seizure disorders, hyperventilation, drugs and alcohol, dementia, frailty and other conditions causing loss of consciousness, e.g. low blood sugar in a diabetic. These conditions should be suspected in known competent swimmers found drowned unexpectedly. In some victims these medical conditions can be aggravated by the shock of sudden immersion in cold water.

Spinal injuries occurring in the water
Spinal injury occurring concurrently with drowning is rare, estimated at less than 0.5% but should be suspected if the victim dived into shallow water, is found in an area of dumping surf, rocks or after an accident involving a boat or other aquatic craft.[4] Remove the victim from the water taking care to keep the airway clear of wave splash while minimising movement of the spine in any direction. Airway management takes precedence over a suspected spinal injury and an unconscious, non-breathing victim should be removed immediately from the water by whatever means possible.

Concurrent hypothermia
There is no evidence that drowning in colder water has an increased survival rate compared with warmer water, yet the literature yields many case reports of successful outcomes of victims rescued from icy waters, even after prolonged resuscitation efforts. Hypothermia is more likely due to prolonged immersion time and ongoing cooling during resuscitation at the scene, in a wet, open environment.

In-water resuscitation
In-water resuscitation may improve survival of victims who are in the initial stages of the drowning sequence but delays time to full assessment and CPR.[3,5] Remove the victim from the water as soon as possible, and only begin in water rescue breathing if immediate removal from the water is delayed or impossible. Rescue breathing in deep water requires an appropriately trained rescuer and floatation aid such as a rescue board, tube or buoyancy vest. In water, chest compressions are ineffective and should not be attempted.

Use of the AED
If available, the AED should be attached and the prompts followed. Dry the victim's chest before applying pads. Although the rhythm deterioration in drowning is usually to a non-shockable rhythm, the AED may be lifesaving in ~6% of drowning victims who, on initial assessment, are found to have a shockable cardiac rhythm.[6]

Compression-only CPR is not the recommended resuscitation method
The primary cause of cardiac arrest in drowning is a lack of breathing. Compression-only CPR circulates oxygen-poor blood and fails to address the victim's need for immediate ventilation. It is not the recommended resuscitation method in a victim of drowning and should only be used temporarily if the rescuer is unable or unwilling to perform rescue breathing before the arrival of a barrier device, face mask or bag-valve-mask device.

LEVEL OF EVIDENCE **III**

CLASS OF RECOMMENDATION **A**

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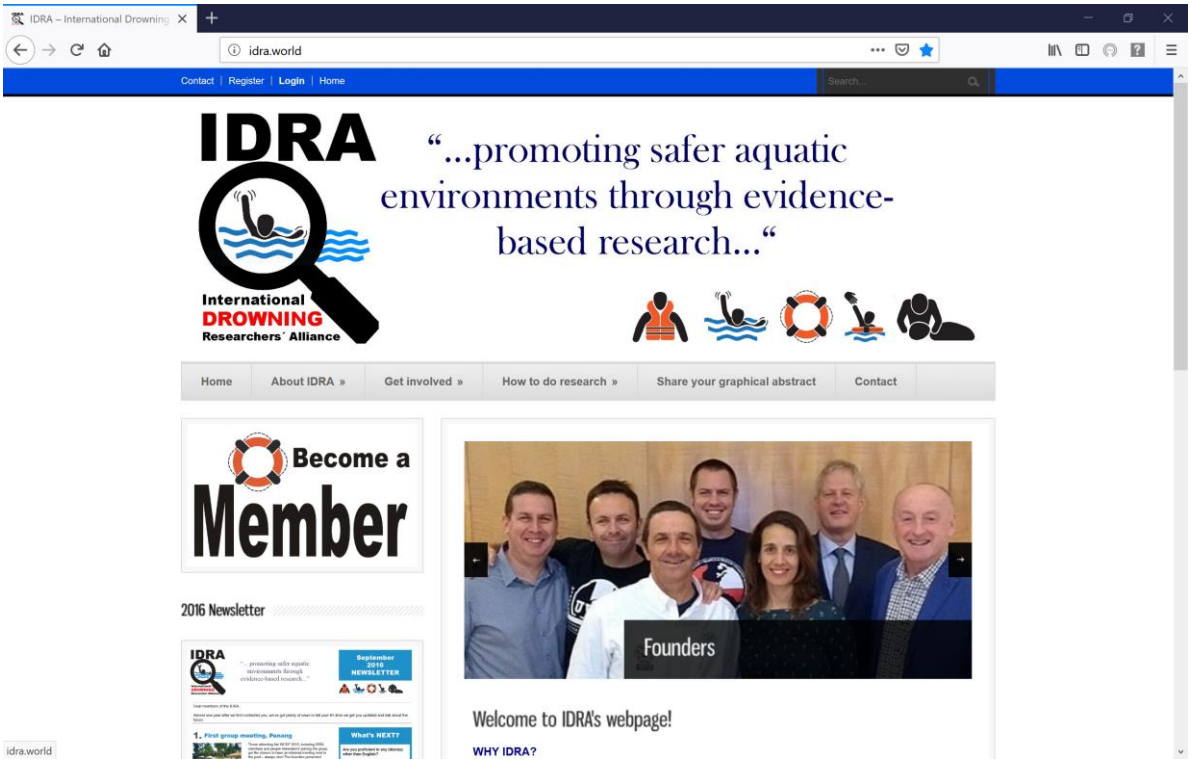
ADDITIONAL RESOURCES

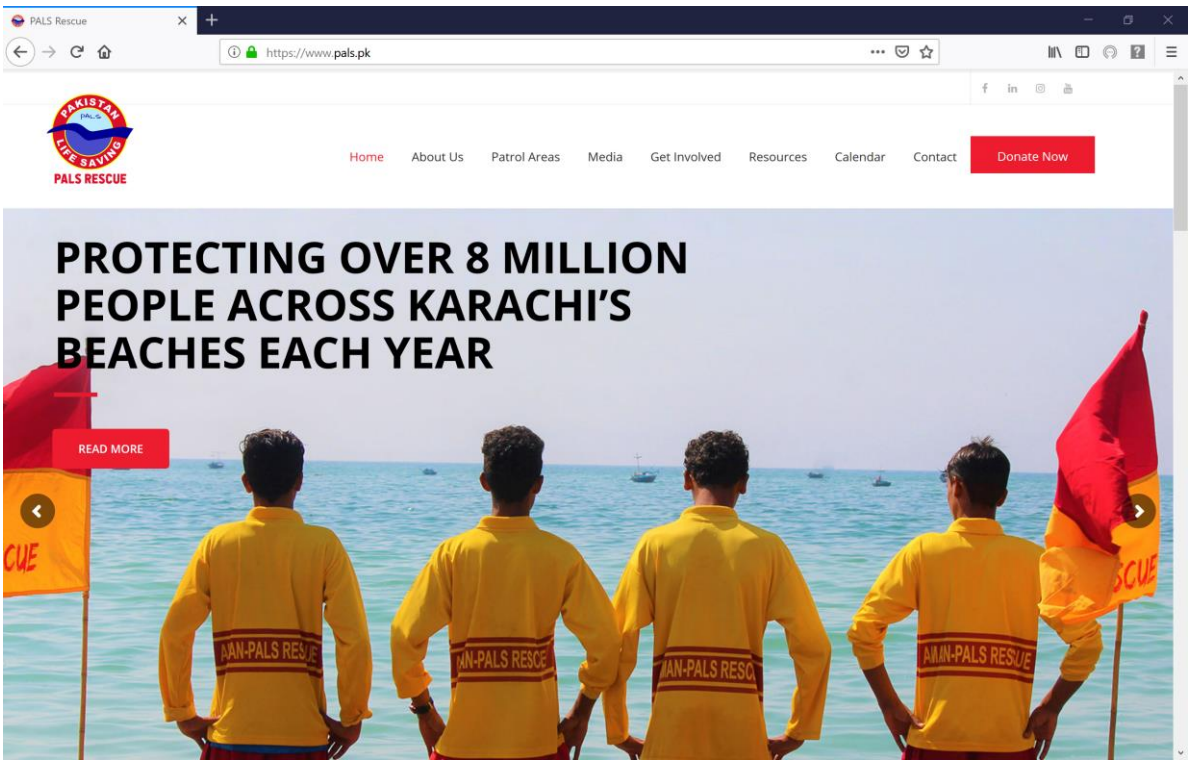
- Surf Life Saving Australia: Public Safety and Aquatic Rescue Manual 33rd Edition Revised November 2011
- Royal Life Saving Society Australia: Lifeguarding 4th Edition

FURTHER READING

ARC Guideline 3 Unconsciousness
ARC Guideline 4 Airway
ARC Guideline 5 Breathing
ARC Guideline 8 Cardiopulmonary Resuscitation
ARC Guideline 9.1.6 Management of Suspected Spinal Injury
ARC Guideline 9.3.3 Hypothermia: First Aid and Management
ARC Guideline 10.4 The Use of Oxygen in Emergencies

Appendix C: Examples of public works in establishing an international drowning research organisation and national aquatic safety agency





Appendix D: Examples of public works in applied lifeguarding practice

Anaesth Intensive Care 2011; **39:** 675-677

Failure to ventilate with supraglottic airways after drowning

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SUMMARY

We report the failure of an i-gel® and an Ambu® AuraOnce™ supraglottic airway to ventilate a drowning victim. Failure was attributed to changes in lung physiology following submersion and inhalation of water that may have required ventilation pressures up to 40 cmH_2O to treat the victim's hypoxaemia. The ease of use and rapid insertion of supraglottic airways without interrupting cardiac compression has prompted recommendations for their use during resuscitation. The relatively low leak pressures attainable from many supraglottic airways, however, may cause inadequate lung ventilation and entrainment of air into the stomach when these devices are used in drowning victims.

Key Words: drowning, pre-hospital, cardiac arrest, supraglottic airway, laryngeal mask airway

When managing a drowning victim, early treatment of hypoxaemia is imperative. Early rescue breathing or positive pressure ventilation, ideally with oxygen, increases survival[1,2]. Recommended airway management for drowning victims includes mouth-to-mouth resuscitation, bag-valve-mask ventilation, endotracheal ventilation or an emergency airway adjunct such as a laryngeal mask, King Tube®, Combitube™ or cricothyroidotomy[3]. In the event of cardiopulmonary arrest, the European Resuscitation Council Guidelines recommend airway protection, ideally with a cuffed endotracheal tube. The relevant guideline notes the limitations of supraglottic airway devices in the presence of reduced pulmonary compliance[4]. Supraglottic airways (SGA) are suggested as an alternative to tracheal intubation during resuscitation after drowning[5]. We could find no reports of SGA use during drowning resuscitation. This report was approved by the Northern X Regional Ethics Committee.

CASE HISTORY

A 25-year-old male, approximately 90 kg, was retrieved from the sea by an inflatable rescue boat and returned to shore in an unresponsive, non-breathing and pulseless state. Lifeguards commenced resuscitation on the beach including cardiac massage and bag-valve-mask ventilation. An automated external defibrillator confirmed asystole. The patient was noted to have significant gastric distension and poor chest expansion despite two person bag-valve-mask ventilation using 100% oxygen with a disposable Laerdal resuscitator.

An experienced resuscitation expert (JW) inserted a lubricated size 4 i-gel® (Intersurgical, Wokingham, Berkshire, UK) without stopping chest compressions. Suction was not available. Ventilation through the i-gel was very difficult and chest movement was not visible. Inflation pressures could not be measured. The i-gel was removed and replaced with bag-valve-mask ventilation by JW. Adequate chest movement without an audible leak was restored with a double 'C-E grip' combined with a head tilt/jaw thrust manoeuvre. An oropharyngeal airway was not used. There was no evidence of vomit or regurgitation.

After 30 minutes of cardiopulmonary resuscitation, paramedics arrived by helicopter and ambulance and advice was given to insert a size 5 Ambu® AuraOnce™ Disposable Laryngeal Mask (Ambu, Ballerup, Denmark)[6]. This device also proved to be unsuccessful with inadequate chest movement and was therefore removed. Bag-valve-mask ventilation was resumed successfully for a further 10 minutes at which time resuscitation efforts were terminated.

The patient had been previously fit and well. A postmortem was not conducted. The coroner ruled that drowning was the cause of death.

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DISCUSSION

Some supraglottic airway devices may be unsuitable for drowning victims because they do not allow high pressures during positive pressure ventilation. Leakage pressures are low in relation to those pressures required to overcome airway resistance (Table 1). The pathophysiological sequence for a drowning victim following submersion involves breath-holding then laryngospasm followed by water aspiration. Lung compliance has been shown to decrease by up to 66% within five minutes of relatively small quantities (1 to 3 ml/kg) of lung sea water inhalation in experimental animals. This fall in compliance has been attributed to widespread closure of terminal airways, compounded by a variable increase in non-elastic resistance caused by fluid and foam blocking the airways[6]. The resulting uncorrected hypoxaemia leads to cardiac arrest. Safe positive pressure ventilation is required to overcome this high lung resistance. It is estimated that following inhalation of water and the rapid drop in lung compliance, ventilation pressures of three to 10 times the pressures required before the introduction of fluid into the lungs are necessary to maintain the same tidal volumes[6]. A maximum inflation pressure of 40 cmH_2O is recommended for normal lungs, based on flow-volume loops[7], which is an appropriate normal upper limit when considering the drowning victim may have a mixture of closed and open airways. Transpulmonary pressures in excess of 80 cmH_2O risk complications such as interstitial emphysema and air embolism[8].

Correct anatomical location, cuff pressure and size of the SGA will affect airway leak pressures. Airway leak pressures can be measured during anaesthesia by fixing the fresh gas flow to 3 l/minute, adjusting the expiratory valve of the breathing circle to 40 cmH_2O and recording the airway pressure at equilibrium. Relatively low leak pressures for the i-gel (19.3, SD 7.1 cmH_2O)[9] and the Ambu AuraOnce (24.1, SD 5.44 cmH_2O)[10] may explain the inadequate lung ventilation we experienced when attempting to ventilate our drowning victim with both SGAs. It is also possible that a suboptimal fit of the SGAs occurred after insertion by relatively inexperienced users of these devices, especially during resuscitation.

The use of SGAs in drowning victims has not been described. The i-gel is a disposable SGA made of thermoplastic elastomer, with a gastric drainage tube and a bite block. The i-gel is indicated by the manufacturers for "securing and maintaining a patent airway in routine and emergency anaesthetics of fasted patients, during spontaneous or intermittent positive pressure ventilation, and during resuscitation of the unconscious patient, by personnel who are suitably trained and experienced in the use of airway management techniques and devices"[11]. Several case series confirm the successful use of the i-gel during elective anaesthesia, and it has been suggested that it may have a place during resuscitation[12]. Reservations have been expressed, however, concerning unsatisfactory performance of the i-gel in the pre-hospital setting[13]. The Ambu AuraOnce Disposable Laryngeal Mask is intended for use in fasted patients as an alternative to a facemask during routine and emergency anaesthetic procedures[5]. There are no reports of i-gel or Ambu AuraOnce use for resuscitation in drowning victims.

A range of ventilation techniques has been suggested for victims of drowning. Tracheal intubation has the advantage of providing a clear secure airway with positive pressure ventilation in the presence of low lung compliance and high airway resistance. The disadvantages of this technique during pre-hospital resuscitation include the risk of unrecognised oesophageal intubation, tube displacement and prolonged intubation attempts interrupting cardiopulmonary resuscitation. The ease of use and rapid insertion of SGAs without interrupting cardiopulmonary resuscitation has prompted recommendations for their use during

TABLE 1
In vivo cuff pressures and airway leak pressures for supraglottic airways

Device	Cuff volume, ml	Cuff pressure, cmH_2O	Airway leak pressure, cmH_2O
i-gel[9]	NA	NA	19.3*±7.1§
Solus LMA[9]	Maximum allowable volume for size		22.6*±7.7§
AuraOnce[10]	Maximum allowable volume for size	60	24.0*±5.5§ (10-40)
ProSeal LMA[15]	20	60	25† [20-33] (11-40)
LaryngealTube S[13]	70	65	28† [20-34] (14-40)
Combitube[15]	75	250	34† [25-40] (15-40)

Data are mean *, median †, standard deviation §, [interquartile range] and (range).

resuscitation[14]. This case report suggests that SGAs are unsuitable for resuscitation of drowning victims.

CONFLICT OF INTEREST

Dr Baker has received free airway equipment for research and teaching from a number of manufacturers including Intersurgical and Ambu.

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ORIGINAL ARTICLE

Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards

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Aim: To conduct a comprehensive analysis of surf lifeguards' real and perceived ability in paediatric cardiopulmonary resuscitation (CPR), knowledge of child resuscitation protocols and technical competency during a simulated CPR scenario.

Methods: Surf lifeguards aged 16 years and over were invited to complete a written survey and simulated test of five cycles of single-rescuer CPR on a paediatric manikin. In accordance with the latest Australia and New Zealand Committee on Resuscitation (ANZCOR) guidelines, practical skills were assessed by trained observers. A manikin fitted with electronic data-collection capability recorded technical compression and ventilation skills.

Results: A total of 244 participants were entered into the study. Most previous CPR training did not include a paediatric component (53%). Lifeguards rated their ability to perform CPR on an adult as 'highly effective' or 'effective' in 56% of responses. Less than a quarter (23%), however, gave this response when compared to a child. Observed CPR skills were mostly compliant with ANZCOR guidelines (80–99%). Manikin data provided a median compression rate of 115.6 min^{-1}, compression depth of 3.7 cm and tidal volume of 220.0 mL. Almost half of ventilations were too little (45%), and around one fifth were too much (22%).

Conclusions: Surf lifeguards are less confident in paediatric CPR. The overall performance of observed and technical CPR skills, which were mostly ANZCOR guideline compliant, suggests that performance could be improved if paediatric-specific training is provided to supplement the adult-focused methods currently in use. The use of electronic feedback manikins is recommended to address the technical compression and ventilation issues identified in this study.

Key words: cardiopulmonary resuscitation; drowning; education; first aid; injury prevention.

What is already known on this topic

1 Drowning is the second leading cause of unintentional paediatric mortality world-wide.
2 Prompt rescue and basic life support on-scene offers drowning patients the best chance of survival.
3 Lay rescuers are less confident in their ability to perform cardiopulmonary resuscitation (CPR) on a child.

What this paper adds

1 This is the first study of paediatric CPR skills and attitudes amongst first responders.
2 Some lifeguards do not push hard enough on the chest during CPR.
3 Many lifeguards are unsure about their ability to perform CPR on a child.

Drowning is a significant public health issue and leading cause of unintentional injury death, especially in low- and middle-income countries.[1] For children aged 0–17 years, drowning is second only to road traffic injuries as a prime cause of mortality from unintentional injury.[2] Despite high-income countries like Australia and New Zealand having established national water safety plans supported by an integrated network of lifeguard, rescue and emergency medical services, drowning remains a leading cause of paediatric death.[3–6]

A recent study in Queensland reported that, for every fatal drowning involving a child or adolescent, 10 others were rescued, may have required resuscitation and survived. Two thirds of these survivors required hospitalisation.[7] Prompt rescue and resuscitation on-scene offers patients the best chance of survival, with the only factor shown to be prognostic of survival being submersion duration.[8,9] For this reason, lifeguards play a critical role where rescue and resuscitation is required given the ever-present risk of drowning at beaches and other aquatic locations.[10]

Moran and Webber have previously investigated perceptions, knowledge and simulated performance of cardiopulmonary resuscitation (CPR) by lifeguards.[11,12] However, the focus of these and other lifeguard-related studies was on adults.[13–15] No studies have investigated this in a paediatric context despite lifeguards

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having a duty of care to resuscitate a patient of any age. Resuscitation in children requires modification to the techniques used in adults. These relate to compression depth, ventilation volume, number of hands used to deliver compressions and when to leave the patient to summon help if alone.[16]

Studies concerning the effectiveness of paediatric-specific resuscitation training have focused on health professionals, not first responders.[17–19] While the clinical aspects of drowning in children and technical aspects of lifeguard CPR have been reviewed, no study has asked lifeguards to rate their confidence if confronted with an adult versus paediatric scenario.[20–22] Among lay rescuers, anxiety levels are higher and confidence levels lower when respondents self-rate their ability to perform CPR on a child.[23,24]

The purpose of this study was to conduct a comprehensive analysis of surf lifeguards' real and perceived ability regarding paediatric CPR, knowledge of child resuscitation protocols and technical competency during a simulated CPR scenario. It was hypothesised that lifeguards would be less confident in their ability to perform paediatric CPR and that their knowledge and practical test results would reflect the adult-focused nature of their prior training.

Methods

Study design

The research design used was a mixed method, cross-sectional study using a self-complete questionnaire followed by a practical CPR skills assessment on a manikin. The setting for the study was surf life saving patrol locations at beaches in the northern region of New Zealand. Data were collected between November 2016 and January 2017.

Before the study commenced, ethics approval was obtained from the University of Auckland Human Participants Ethics Committee (reference number 018165). Informed consent was obtained from each participant after written and verbal explanations of the study were provided.

Participants

The participants in the study were paid and volunteer surf lifeguards aged ≥16 years. All surf lifeguards are trained and refreshed in CPR to a national standard, as specified by Surf Life Saving New Zealand. Lifeguards with a health professional background were excluded from the study as these individuals receive additional training in paediatric CPR and follow a different protocol than non-health professionals under the current Australia and New Zealand Committee on Resuscitation (ANZCOR) guidelines.[25]

Data sources/measurement

The practical skills test was conducted using a Laerdal Little Junior (Laerdal Medical AS, Stavanger, Norway) CPR manikin fitted with HeartiSense (I.M. LAB, Daejeon, Republic of Korea), an electronic data collection system capable of reporting on a range of resuscitation parameters, for example, compression depth (Fig. 1). The Laerdal Little Junior manikin is intended to simulate a 5-year-old child. Observed skills were based on the 2016 ANZCOR basic life support algorithm, as used by Surf Life Saving New Zealand in the training of lifeguards.[26]

In accordance with the ANZCOR guidelines, correct compressions on the manikin were those recorded as ≥5 cm in depth, delivered at a rate of 100–120 min^{-1} and using a compression-to-ventilation ratio of 30:2.[16,26] Correct ventilations were those delivered with a tidal volume of 200–300 mL. Manikin data were captured over five cycles of CPR by the HeartiSense system.

Procedures

Standardised test procedures were developed based on the study design used in two previously published studies of a similar cohort.[11,12] A team of two assessors was randomly assigned to visit lifeguard-patrolled beaches. Lifeguards were invited to voluntarily take part in the study. Those lifeguards who agreed to take part were asked to complete a 14-part written survey. At the completion of the survey, participants were then individually assessed on their practical CPR skills in a designated testing room. Participants were read a scenario briefing card, and observed CPR skills were recorded by the assessors using a standardised dangers, responsiveness, airway, breathing, CPR (DRSABC) checklist. Technical CPR skills were recorded through HeartiSense, commencing with the delivery of the first chest compression.

To minimise the effect of observer bias during the practical CPR skills test, assessors received training from an experienced advanced life support instructor prior to the commencement of the study. During training, results from each observer were compared, discrepancies discussed and further scoring conducted until there was agreement. All assessment sheets were reviewed by the principal investigator.

Study size

Of the 1500 surf lifeguards in the northern region of New Zealand, 250 were enrolled in the study. Five cases were excluded from the final analysis because of equipment malfunction during the practical test and one where the participant later revealed that he or she was a health professional, leaving a sample of 244 lifeguards.

Data analysis

Our primary outcome was the description of data from the study. Data from the completed questionnaires and manikin test results were entered in SPSS, version 24 (IBM, New York, NY, USA) for statistical analysis. Descriptive statistics described or characterised all numeric variables using frequency and percentages. Continuous variables, including eight observed skills during simulated CPR over five cycles (Table 3), five compression skills via electronic recording (Table 4) and four ventilation skills via electronic recording (Table 5), are reported using measures of central tendency and dispersion (mean, standard deviation, median and range).

Chi-square statistics were used to test associations between the independent socio-demographic variables of age (divided into four groups), gender and length of service against CPR competencies. A P value of 0.05 was considered significant.

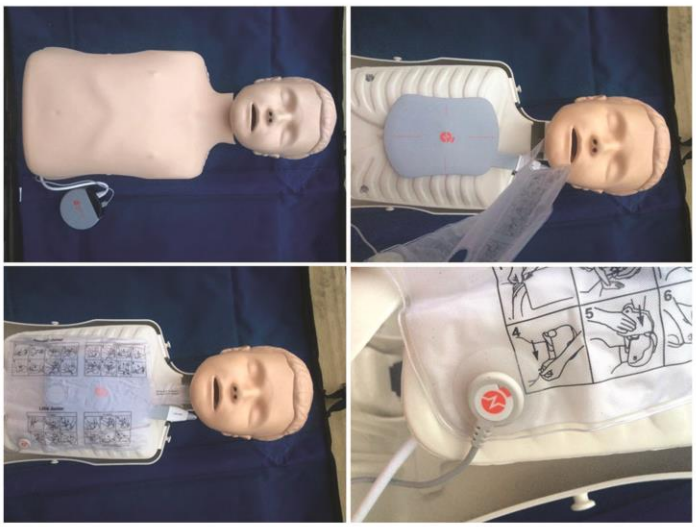

Fig. 1 Four photographs of the HeartiSense electronic data collection/feedback system fitted to a Laerdal Little Junior manikin. From top left in clockwise order: Manikin data input module (connected via Bluetooth to the tablet computer); HeartiSense chest compression sensor with manikin chest skin and lungs removed; manikin lungs with HeartiSense ventilation sensor attached *in situ* on top of the chest compression sensor; close-up of HeartiSense ventilation sensor attached to manikin lungs.

Results

Lifeguard demographics, CPR training and experience

The sample included more male than female participants (male 58%, female 42%); 41% of lifeguards were less than 20 years of age (and 14% were over 45 years of age), and 62% had less than 6 years of lifeguard experience. Two-thirds (66%) had received CPR training in the 3 months prior to the study; a further 25% had received training in the previous 2 years. When asked to rate the efficacy of their CPR training, most lifeguards (68%) rated it as highly effective (12%) or effective (56%), one quarter thought it satisfactory (27%), and a small proportion (<5%) thought it less than satisfactory. More than half (53%) reported that their CPR training had not included paediatric-oriented training, and most (73%) had received no electronic feedback manikin training. Very few participants (<2%) had actually performed child CPR when on duty at the beach.

Perceived ability to perform CPR on a child

Participants reported being significantly more confident about performing adult CPR compared with child CPR (χ^2 (20) = 218.835, P = <0.001). Most participants (56%) considered that they were either highly effective (6%) or effective (50%) at performing adult CPR compared with only 23% of participants who reported the same for paediatric CPR (Table 1).

No significant differences were found when estimates of ability to perform either adult or child CPR were analysed by gender, age group or length of lifeguard service.

Theoretical knowledge of paediatric resuscitation

When asked about their knowledge of child CPR protocols, most respondents (n = 224; 92%) reported the correct ratio of compressions to ventilations (30:2). Fewer (n = 167; 68%) reported the correct rate of compressions (100–120 min^{-1}).

In a series of true/false statements, participants were asked about child-specific CPR protocols (Table 2). Table 2 shows, in descending order, the number (and percentage) of participants who correctly answered each question. Most lifeguards (>80%) correctly answered five of the child-related CPR statements, but less than half correctly answered questions regarding the recommended depth of compression being ~5 cm (43%) or that the first step when approaching a collapsed child is not to check responsiveness (38%) (the correct first step is to check for danger).

In a multiple choice question on which factor has the greatest impact on the successful outcome of CPR intervention in

Table 1 Perceived ability to perform cardiopulmonary resuscitation on an adult versus child

	Adult		Child	
Perceived ability	*n*	%	*n*	%
Highly effective	15	6.1	5	2.0
Effective	122	50.0	51	20.9
Satisfactory	78	32.0	106	43.4
Fair/Poor	15	6.1	52	21.3
Don't know	14	5.7	30	12.3
Total	244	100.0	244	100.0

Journal of Paediatrics and Child Health **55** (2019) 156–161

Table 2 Understanding of paediatric cardiopulmonary resuscitation (CPR) protocols

Knowledge statement	True/ False	Correct response	
		n	%
Stop performing CPR on any child that has not recovered within 15–20 min	False	224	94.5
Take up to 10 s to check for breathing before starting CPR on a child	True	227	93.8
If the child's airway is blocked, start CPR first and then clear the obstruction	False	227	93.4
An automated external defibrillator can safely be used on a child	True	211	87.2
Chest compression-only CPR should be used on any child that has drowned	False	190	80.0
If alone with a child, go for help first before starting CPR	False	166	68.0
For children, each rescue breath should be delivered over 1 s	True	143	60.1
The correct depth of chest compressions for a child is approximately 5 cm	True	102	42.5
When approaching a collapsed child, the first step is to check responsiveness	False	92	37.9

drowning incidents, almost half (44%) correctly selected submersion duration as the critical factor, and one quarter considered time to application of a defibrillator (24%) or quality of CPR (27%) to be the critical factors. No significant differences were found when any of the knowledge responses were analysed by gender, age group or length of lifeguard service.

Observed paediatric CPR skills

When observed performing simulated CPR on a child-sized manikin, most participants (80–99%) appeared to apply the DRSABC sequence and perform CPR correctly (Table 3).

Table 3 Observed cardiopulmonary resuscitation (CPR) skills in child manikin simulation

Observed skill	Correct response	
	n	%
Danger (checks safe to approach)	196	80.3
Responsiveness (checks using voice and touch)	238	97.5
Send for help (shouts for help/sends a bystander to summon assistance)	216	88.5
Airway (opens airway using head-tilt/chin-lift)	198	81.2
Breathing (checks breathing for up to 10 s)	231	94.7
Chest compressions (commences CPR)	243	99.6
Correct compression/ventilation ratio (30:2)	221	90.6
Maintains airway between sets of compressions	220	90.2

No significant differences were evident when observed CPR skills performed on a child manikin were analysed by gender. Significantly more (χ^2 (3) = 8.702, P = 0.034) younger lifeguards than older lifeguards correctly sought help when assessing a child patient (91% for 16–19-year olds and 20–29-year olds and 92% for 30–44-year olds but only 73% for 45+-year olds). Significantly more lifeguards (χ^2 (4) = 14.298, P = 0.006) with greater length of service checked for danger (>10 years' service, 29%, <10 years' service, 6%). No other significant results were found.

Technical chest compression skills

Compression rates (median of 115.6 min^{-1}) were within the recommended range of 100–120 compressions per minute. However, the mean number of compressions delivered (137.4) was less than the 150 that should have been given over five cycles of CPR. Most chest compressions (median of 3.7 cm) were less than the 5 cm recommended for a child, and one quarter (mean = 24.8 ± 36.2%) of participants' compressions involved a wrong hand position.

However, participants performed very few incomplete releases (mean = 0.2 ± 1.7%). An incomplete release occurs when residual pressure is left on the chest preventing it from fully recoiling.

No significant difference was evident in wrong hand position by participant gender. Significant differences were evident when analysed by age (χ^2 (4) = 16.011, P = 0.003), with younger participants having more errors (72% for 16–19-years olds and 44% for 45+-year olds). Significant differences were also evident when analysed by experience (χ^2 (4) = 16.011, P = 0.003), with less experienced lifeguards making more mistakes. There were no significant differences for incomplete releases (Table 4).

Technical ventilation skills

Ventilation tidal volumes (mean = 248.8 ± 108.5 mL) were within the recommended range of 200–300 mL. However, the total number of ventilations (mean = 6.5 ± 3.5) delivered by lifeguards was less than the 10 that should have been given over five cycles of CPR.

In terms of technical errors, participants under-ventilated in almost half their breaths (mean = 45.4 ± 38.0%) and over-ventilated in an average of one fifth (mean = 21.9% ± 32.5).

There were no significant differences in the errors of too little or too much ventilation (Table 5).

Table 4 Technical chest compression skills in child manikin simulation

Chest compression skills	Mean	SD	Median	Range
Total chest compressions delivered	137.4	31.5	150	9–206
Compression rate, min^{-1}	115.3	15.5	115.6	76.1–179.0
Depth of chest compressions, cm	3.1	1.7	3.7	0–6.1
Technical errors				
Wrong hand position, %	24.8	36.2	3.6	0–100
Incomplete release, %	0.2	1.7	0	0–15

Table 5 Technical ventilation skills in child manikin simulation

Ventilation skills	Mean	SD	Median	Range
Total ventilations delivered	6.5	3.5	8.0	0–15
Tidal volume of ventilations, mL	248.8	108.5	220.0	108–500
Technical errors				
Too little volume, %	45.4	38.0	40.0	0–100
Too much volume, %	21.9	32.5	0.0	0–100

We compared the outcome measures in Tables 4 and 5 with participant's responses to the survey questions about whether their last training included a paediatric component and if they had used a CPR manikin with electronic feedback in the past 3 years. There were no significant differences.

Discussion

This is the first study to investigate surf lifeguards' real and perceived ability in paediatric CPR. Lifeguards felt more confident in adult CPR than child CPR. The reasons for this were not studied. Lifeguards applied the DRSABC approach to a simulated child collapse with a high degree of compliance, suggesting that many elements of adult collapse, which is the mainstay of lifeguard training, can be applied in paediatrics.

An important finding from this study was the tendency for most lifeguards to not push hard enough on the chest. Inadequate compression depth has been associated with poor outcomes.[27] Although excessive compression depth may be detrimental, ANZCOR have not placed an upper limit on this as the risk of shallow compressions on the chest is deemed to outweigh the risk of compressing too deep.[16,25] Median chest compression rate was in accordance with ANZCOR guidelines (100–120 min^{-1}) but ranged from 76.1 to 179.0 min^{-1}. There is some evidence to suggest that compressing too fast or two slow on the chest is associated with lower survival rates.[27,28]

Median ventilation tidal volume was also within the recommended range. However, participants under-ventilated in approximately 45% and over-ventilated in approximately 20% of their breaths. Low tidal volume may result in inadequate oxygenation, whereas excessive tidal volumes will cause/worsen gastric distention, making it difficult to ventilate the patient.[29] Another complication that typically occurs with excessive ventilation is regurgitation, which will obstruct the airway unless cleared.

Despite two thirds of participants having undergone CPR training/re-training in the 6 months prior to the study, over half stated that it contained no paediatric-specific component. Given that lifeguards have a duty of care to patients of all ages, it is concerning that only some are being trained in paediatric CPR. Whilst the optimal frequency and format of CPR training is not known, ANZCOR recommend that all rescuers trained in CPR take refresher courses annually.[30] Technical competency in CPR skills declines rapidly after training, with some skills deteriorating within 30 days of attending a course.[31]

Almost three quarters of participants had not been trained on electronic feedback manikins. The use of feedback devices in conjunction with short duration, on-site training has been shown in other studies to improve compression depth and rate compliance.[18,32] A recent study that looked at the quality of simulated infant CPR, however, showed no clinically significant difference in technique or chest compression quality when instructor-led training was compared with use of a metronome or feedback device.[33]

No significant differences were evident in outcome measures by participant self-reporting of recent training or training with a feedback manikin. However, the study was not powered for such a result, and the data are self-reported. Furthermore, we did not evaluate the quality of training or how recent it was.

Although more studies are needed, the authors believe that electronic feedback manikins should be the 'gold standard' for CPR training as relying on feedback from an observer is both subjective and, especially in a paediatric setting, may be inaccurate.[12,34]

Limitations

While the results of this study provide the first insight into surf lifeguard paediatric CPR perceptions and practice, several limitations should be considered.

The study did not determine the reasons why lifeguards were less confident in paediatric compared to adult CPR. This information will be of particular interest to those organisations and educators who intend to address or further research this issue.

CPR manikins can only simulate cardiac arrest up to a point. They do, however, provide a standardised platform on which training and performance can be assessed. In addition, the electronic feedback system used in this study was only used for testing. The intended use of this system is for students to practice via mastery (using real-time audio and visual feedback) before attempting assessment.

We did not perform any formal statistical test for agreement of the two assessors for the practical CPR test. However, the randomised nature of the experiment means any deviations should not systematically affect any results.

Surf lifeguards on duty never work alone, and the presence of a team with resuscitation equipment may have influenced these results. As a single-centre study, the generalisation of these results to other first responders and lifeguards from other jurisdictions is limited.

Annual refresher CPR training for lifeguards does not contain a paediatric-specific component; therefore, those lifeguards whose most recent training was a refresher would not have had an opportunity to practice these skills.

Finally, there is no evidence to show that performance in a simulated cardiac arrest has any impact on actual patient outcomes.

Conclusions

Surf lifeguards are less confident in their ability to perform CPR on a child. If trained in adult CPR, lifeguards can competently apply the DRSABC reaction mnemonic in a simulated paediatric scenario. From a technical perspective, however, this may not result in high-quality chest compressions or ventilations being delivered. It seems prudent therefore to recommend that paediatric-specific training using electronic feedback manikins be incorporated into existing lifeguard CPR education programmes to address these issues. Further studies are needed, however, to determine the efficacy of these recommendations.

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Appendix E: Sentinel Full System for Response to Drowning

SENTINEL SYSTEM FOR DROWNING RISK STRATIFICATION Detection					
STATUS	Drowning			At Risk of Drowning	
	ONE	TWO	THREE	FOUR	FIVE
Threat to Life	IMMEDIATE	CRITICAL	SERIOUS	MODERATE	LOW
Stage of Drowning	Terminal	Crisis	Distress	At Risk	Low Risk
Behaviour Displayed	1. Involuntary submersion 2. Floating "face down" 3. Unconscious 4. Cardiac or respiratory arrest 5. Witnessed seizure in water	1. Instinctive drowning response (late signs of distress) 2. Unable to signal or call for help	1. Signs of distress 2. Loss of flotation 3. May not be able to signal or call for help	1. Early signs of distress 2. Afloat; makes poor progress 3. May have flotation 4. May call or signal for help 5. Not coping with hazards 6. Prolonged period at status 4	1. No signs of distress 2. Hazard present 3. Standing (or able to stand) 4. Effective swimming 5. Has flotation 6. Can call or signal for help 7. Coping with hazards

SENTINEL SYSTEM FOR DROWNING RISK STRATIFICATION Response					
STATUS	Drowning			At Risk of Drowning	
	ONE	TWO	THREE	FOUR	FIVE
Threat to Life	IMMEDIATE	CRITICAL	SERIOUS	MODERATE	LOW
Stage of Drowning	Terminal	Crisis	Distress	At Risk	Low Risk
Response Required	1. Urgent rescue with multiple rescue assets 2. Continuous surveillance 3. Buoyancy support + / - in-water BLS 3. Call for an ambulance 4. CPR and/or patient care as required	1. Urgent rescue 2. Continuous surveillance 3. Buoyancy support 4. Additional rescue assets on standby 5. Patient care as required	1. Immediate rescue 2. Continuous surveillance 3. Buoyancy support (if required) 4. Patient care as required 5. Education as appropriate	1. Routine or Immediate rescue 2. Continued surveillance 3. Patient care as required 4. Education as appropriate	1. Possible extraction from hazard (preventative action) 2. Surveillance 3. Routine rescue 4. Education as appropriate

SENTINEL SYSTEM FOR DROWNING RISK STRATIFICATION
Lifesaving Skills Required

STATUS	ONE	TWO	THREE	FOUR	FIVE
Threat to Life	IMMEDIATE	CRITICAL	SERIOUS	MODERATE	LOW
Lifesaving Education	Core skills plus: 1. Multi-agency response training 2. Scene management 3. Body recovery 4. Buoyancy support 5. In-water BLS 6. Oxygen therapy 7. Bag/mask 8. AED 9. Vital signs	Core skills plus: 1. Buoyancy support 2. Oxygen therapy 3. Bag/mask 4. AED 5. Vital signs	Core skills plus: 1. Buoyancy support 2. Oxygen therapy 3. Bag/mask 4. AED 5. Vital signs	Core skills plus: 1. Buoyancy support 2. Oxygen therapy 3. Vital signs	Core skills: 1. Preventive lifeguarding 2. Drowning detection 3. Levels of rescue response 4. Patient assessment and care 5. CPR 6. Recovery position 7. Public education

SENTINEL SYSTEM FOR RESPONSE TO DROWNING

STATUS	ONE	TWO	THREE	FOUR	FIVE
Threat to Life	IMMEDIATE	CRITICAL	SERIOUS	MODERATE	LOW
Behaviour Displayed	Submerged or Unconscious	Instinctive Drowning Response	Distress	Early Distress	No Distress (Hazard Present)
Response Required	Urgent Rescue (multi-level) Buoyancy Support + / - in-water BLS Call for Ambulance	Urgent Rescue Buoyancy Support Rescue Assets on standby	Immediate Rescue Buoyancy Support (if required)	Routine or Immediate Rescue	Preventative Action or Routine Rescue
Patient Assessment	Unresponsive and not breathing normally	Large amount of foam in mouth or nose; breathing inadequate or decreased LOC	Large amount of foam in mouth or nose; breathing adequate	Small amount of foam in mouth or nose; lung sounds abnormal	Cough, with no foam in mouth or nose; lung sounds normal
Treatment	Start CPR Bag/mask with high-flow oxygen Attach AED	High-flow oxygen Monitor breathing Vital signs Recovery position	High-flow oxygen Vital signs Recovery position	Oxygen Warm and calm the victim Recovery position	Rest, warm and calm the victim Oxygen not normally required

STATUS FIVE PATIENTS WITH NO OTHER MEDICAL PROBLEMS OR INJURIES CAN BE DISCHARGED INTO THE CARE OF A RESPONSIBLE ADULT. CALL AN AMBULANCE FOR ALL OTHER PATIENTS

Appendix F: Impact assessment of studies by SLSNZ medical director

From: gpayinda <gpayinda@gmail.com>
Sent: Monday, 18 February 2019 08:43
To: Jonathon Webber
Subject: Re: NZ studies

Hi Jonathon,

Thank you for the opportunity to discuss the regional, national, and international impact of the seven publications listed above. They've been valuable in informing and supporting the initiatives SLSNZ is undertaking in resuscitation and first aid training, as well as lifeguard personal safety. Taken one at a time:

Study 1: Paediatric cardiopulmonary resuscitation: Knowledge and perceptions of surf lifeguards.
Mr. Webber's study demonstrated, better than any other to date, the limitations of the current SLSNZ training regime as regards paediatric resuscitation. It showed lifeguard's skills were acceptable, but their confidence levels were low. It also contributed to the initiative at SLSNZ to see electronic feedback manikins incorporated into training more routinely. This has translated into the increased uptake by clubs of manikins, and a push to have them in every surf club within the next few years.

Study 2: Surf, sand, scrapes and stings: First aid incidents involving children at New Zealand beaches, 2007–2012.
One of the few published analyses of the SLSNZ injury data set, looking at paediatric beachgoer injuries, and finding a preponderance of lacerations and stings requiring first aid treatment. This will help shape a response in future training manuals to emphasise these topics.

Study 3: Surfing injuries requiring first aid in New Zealand, 2007-2012.
Illustrated, again using an SLSNZ data set, the incidence of surfing-related injuries at SLSNZ-guarded beaches. The study highlighted several important points, namely: the fairly high prevalence of injuries, the demographic preponderance of males, and the types of injuries sustained: fin-derived lower leg and head lacerations. This could help lifeguards target preventative actions towards these groups, and reiterates the need for guards to keep hard and finned objects out of the swim zone. Again, useful analysis to help inform current revisions of the training programme.

Study 4: Drowning terminology not what it used to be.
Has formed part of the international discussion on proper terminology in drowning, both at national (SLSNZ) and international levels (ILSF) levels, and in media publications, where Mr. Webber has had a platform for improving layperson understanding of what drowning is, and isn't. Given that there is much misunderstanding in the lay media of the physiology and consequences of drowning, Mr. Webber's efforts have been necessary, and useful, at a national level.

Study 5: Too much puff, not enough push? Surf lifeguard simulated CPR performance.
Has helped inform my own teaching efforts with medical students and emergency medicine trainees as well as my efforts in improving CPR education for lifeguards. It adds to what we know about the weaknesses of layperson CPR. Mr. Webber's study illustrated the significant rate at which lifeguards over-ventilated manikin lungs at greater-than-recommended volumes. While we don't know if this translates to real-life resuscitations, it is suggestive enough that it can help modify our lifeguard training to emphasise ventilating at more appropriate tidal volumes. This again has translated into stronger policies advocating for the use of feedback manikins in lifeguard training.

Study 6: Leisure-related injuries at the beach: An analysis of lifeguard incident report forms in New Zealand, 2007-12.
Was again informative for those of us responsible for SLSNZ lifeguard training, showing the high preponderance of lower extremity lacerations using a directly relevant data set from SLSNZ incidents. This study helps support our steps to improve lifeguard personal safety at SLSNZ, specifically in the form

of improving utilisation of universal precautions to prevent bloodborne transmission of infections, and this study will help us emphasise haemorrhage control in the next iteration of lifeguard training materials, over conditions which we see less often, or are less clinically significant.

Study 7: Surf lifeguard perceptions and practice of cardiopulmonary resuscitation (CPR).
Is useful to our organisation in two ways. It shows us that our CPR training is useful; well-appreciated by lifeguards, well-retained, and actually being put to use in the real world. And it shows us very concretely where to put future training emphasis: what to do when you're a sole rescuer, requiring that lifeguards don gloves in a resuscitation, and knowing when AEDs are not at all helpful. These may seem small points of emphasis, but they could translate into very big differences in outcome for a patient or a lifeguard.

Overall Mr. Webber's studies have helped guide SLSNZ training initiatives in CPR, paediatric CPR, and first aid, as well as helped inform my own discussions/initiatives as the SLSNZ medical director. His studies have been discussed within SLSNZ, at the New Zealand Resuscitation Council, and at the International Life Saving Federation. Given that there are not many publications that focus specifically on New Zealand surf lifesaving, the studies that Mr. Webber has performed have been all the more important, relevant, practical and useful.

Regards,

Gary Payinda MD FACEM
Medical Director, Surf Life Saving New Zealand

Appendix G: Water Safety New Zealand member organisations

Accident Compensation Corporation

Aotearoa Women's Surfing Association

Coastguard Boating Education

Coastguard New Zealand

Drowning Prevention Auckland

Education Outdoors New Zealand

Girl Guiding New Zealand

Jet Boating New Zealand

Kiwi Association of Sea Kayakers

Maritime New Zealand

Motutapu Outdoor Education Camp Trust

New Zealand Jet Sports Boating Association

New Zealand Marine

New Zealand Outdoor Instructors' Association

New Zealand Rivers Association for Professional Guides

New Zealand Recreational Fishing Council

New Zealand Sport Fishing Council

New Zealand Stand Up Paddling

New Zealand Swim Coaches & Teachers

New Zealand Underwater Association

New Zealand Water Polo Association

Recreation Aotearoa

Royal Life Saving Society New Zealand

Royal New Zealand Plunket

Royal Port Nicholson Yacht Club – Wellington Ocean Sports

Safekids Aotearoa

Scouts New Zealand

Second Nature Charitable Trust trading as Vector Wero White Waterpark

Sir Peter Blake Marine Education and Recreation Centre

Surf Life Saving New Zealand

Surfing New Zealand

Swimming New Zealand

Te Toki Voyaging Trust

New Zealand Trailer Yacht Association

Waka Ama New Zealand

Whitewater New Zealand

Windsurfing New Zealand

Yachting New Zealand

YMCA North

Youthtown

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